5.8.4.4 Results. OU 3-14 field investigation sampling results are summarized in Table 5-24 and in Table D-1 from Appendix F, respectively. Table 5-24 includes only a subset of analytical results and does not include laboratory or validation flags, sampling errors, or method detection limits (MDLs); "ND" represents compounds that were U- or UJ-flagged; and "0" represents compounds detected at low levels, but the decimal places are not shown. Complete detailed sampling results are provided in Appendix G. No elevated gamma readings were observed during logging of Probehole CPP-27-1 (CPP-1870) during the OU 3-14 field investigation.

Sampling results for Probehole 27-Sample-A (CPP-1871) indicate elevated Cs-137 results from 6 to 20 ft bgs, with a maximum of 288 pCi/g at 14-16 ft bgs. Concentrations of Cs-137 decrease below this depth to nondetect at the completion depth of 27-Sample-B (CPP-1872) at 36 ft bgs. Maximum Sr-90 results are 8 pCi/g, also in the 14-16 ft bgs interval. Concentrations of other COPCs are near or below MDLs.

Concentrations of INTEC liquid waste system listed RCRA constituents cited in INEEL (1999) are provided in Appendix G. Acetone, methyl isobutylketone, and tolune were detected at maximum concentrations of 24, 10.7, and 196 μg/kg, respectively.

5.8.5 Contamination Remaining in Alluvium

This section summarizes results of all investigations and process knowledge of the release in the context of

- Nature of contamination including ranges of contaminant concentrations observed
- Areal and vertical extent of contamination remaining in the alluvium
- Volume of contaminated alluvium present.

5.8.5.1 Nature of Contamination. Borehole CPP-27-1 (old) encountered Cs-137 contamination at 1,370 pCi/g at 6-8 ft bgs, which was considered anomalous since the depth of release was 10 ft bgs. The OU 3-14 sampling location, which is adjacent to CPP-27-1 (old), encountered 40 pCi/g Cs-137 at this depth interval. Contamination observed in 1992 in the OU 3-08 Track 2 investigation at CPP-27-1 (old), as well as the OU 3-14 results, are within the ranges reported in Section 5.18 for backfill. Boreholes CPP-27-1 (old) and new are in previously disturbed areas as discussed in Section 5.18.

The contamination observed in both CPP-27-1 old and new appears chemically and radiologically indistinguishable from contaminated backfill present throughout the CPP-27/33 area. A hypothesis was stated in the OU 3-14 Work Plan (DOE-ID 2004) that leaks from the stack may have produced the shallow contamination in CPP-27-1 (old). Seepages due to blockage in a temporary stack condensate drain line used in 1973-1974 were reported in Significant Operating Occurrence Report 74-31 (Staiger 1974). Anecdotal evidence of earlier leaks circa 1965 is also reported. Seepages of stack condensate were reportedly cleaned up as they were observed and likely could not have migrated the linear and vertical distances observed at CPP-27-1. CPP-27-1 is over 40 ft from the stack, and the minor seepages reported in Significant Operating Occurrence Report 74-31 (Staiger 1974) are not believed to have migrated this far. Stack leaks are discussed further in Section 5.18.

Most of the contamination appears to have been located in the southwest portion of the site, where radiation levels as high as 30 mR/hr were measured below a depth of 20 ft (WINCO 1993b) in Borehole #10. The contamination detected in Boreholes #9 and #10 is likely to have originated from the 12-in., carbon-steel, pressure-relief line. The contamination may have followed the stack condensate drain line that is buried near the Borehole #10 approximately 10 ft bls. Alternatively, these elevated readings could be attributed to localized use of backfill exceeding the 5-mR/hr criterion cited previously.

Field survey methods are not documented and some exceedences of the 5-mR/hr criterion could have occurred as a result of inattention or as an oversight, as discussed in Section 5.18. The readings cannot be conclusively attributed to the original WCF scrub solution release, or to backfill, since the gamma readings and concentrations observed overlap both sources.

The contamination detected in Boreholes #5, #7, #8, and CPP-27-1 is likely related to the contaminated soil that was used as backfill. The contamination detected in CPP-33-1 and Borehole #4 at depths greater than about 7 ft is probably not associated with contaminated backfill. The two holes fall within the outline of the 1983 excavation, but the excavation in that area was relatively shallow (approximately 6 to 7 ft), based on photographs of the construction.

Analytical results determined for CPP-27-Sample-A and –B in 2004 for RCRA metals and organics analyzed for were near or below detection limits or INL Site background concentrations.

5.8.5.2 Vertical Extent. The subsurface radiation profiles indicate that low levels of beta-gamma contamination are present at depths typically greater than 7 ft bgs. Levels of beta-gamma radiation below background were again encountered at depths greater than 20 ft bgs and continued to the top of the basalt for CPP-27-1; levels of beta-gamma radiation below background were also encountered at depths greater than 38 ft and continued to the top of the basalt in Borehole CPP-33-1. From the 1987 data, however, 30-mR beta-gamma radiation was measured at 23 ft bgs and 12-17 mR at 40 ft bgs in Borehole #10, located in the southwest portion of the site within a few feet of the failed stack condensate drain line. Whether the contamination continues below this depth is uncertain, since the depths of the boreholes installed in 1987 were not reported.

5.8.5.3 Areal Extent. Essentially all of the contamination originally released was removed from this site. Relatively minor amounts of remaining contamination were smeared across the excavated and backfilled areas as indicated by the in situ gamma logging and analytical results discussed above. The areal extent of contamination at this site is therefore entirely contained within the tank farm boundary and is discussed in Section 5.18.

5.8.5.4 Remaining Curies. Most of the approximately 1,500 Ci of contamination released at CPP-27/33 has been removed. Relatively minor amounts of contamination remaining due to use of contaminated backfill are described for consolidated backfill and soil sites inside the tank farm boundary in Section 5.18.

5.8.6 Summary

Contamination remains at CPP-27/33 from ground surface to 40 ft bgs, likely due to use of contaminated backfill in previous excavations, as discussed in Section 5.18 for consolidated backfill and soil sites inside the tank farm boundary. Essentially all of the contamination originally released was removed from this site. Relatively minor amounts of remaining contamination were smeared across the excavated and backfilled areas as indicated by the in situ gamma logging and analytical results discussed above, as well as the descriptions of the contamination levels allowed in backfill.

5.8.7 Uncertainties/Data Gaps

No significant data gaps remain for this site. The extent, distribution, and composition of contamination originally released and remaining are adequately known to complete the BRA and FS. Table 5-25 summarizes resolution of data gaps for CPP-27/33. The original leak will be included as a source term to the groundwater model and no credit was taken for the removal of most of the contamination. The external exposure risks posed by the remaining contamination will be assessed under consolidated backfill and soil sites inside the tank farm boundary.

Table 5-25. Summary of data gaps for Site CPP-27/33.

Decision Statements	Extent Known Adequately To Resolve Decision Statement?	Distribution Known Adequately To Resolve Decision Statement?	Composition Known Adequately To Resolve Decision Statement?	Properties[a] Known Adequately To Resolve Decision Statement?
1. Determine whether or not soil exposure risks to future workers at CPP-27 exceed allowable levels, requiring control of the exposure pathway.	Yes. Incorporated into soils inside tank farm boundary (Section 5.18).	Yes. Incorporated into soils inside tank farm boundary (Section 5.18).	Yes. Contaminant composition consistent with conceptual model of release.	Properties information is not needed to resolve Decision Statement 1.
2. Determine whether or not contaminants are transported out of the tank farm soils to the SRPA at rates sufficient to result in COPC concentrations exceeding allowable levels at the exposure point, requiring control of the exposure pathway.	Yes. Source term conservatively estimated.	Yes.	Yes. Contaminant composition consistent with conceptual model of release.	Yes.
3. Determine whether or not a remedial action that includes [GRA][b] best meets FS evaluation criteria to mitigate excess risks, relative to other alternatives.	Yes. Incorporated into soils inside tank farm boundary (Section 5.18).	Yes. Incorporated into soils inside tank farm boundary (Section 5.18).	Yes. Contaminant composition consistent with conceptual model of release.	Yes.

a. Properties refer to physicochemical parameters for fate and transport modeling of groundwater contamination source term and parameters needed to evaluate in situ or ex situ treatment for release sites that present significant risks to groundwater. Knowledge of properties is not needed for sites that do not pose significant groundwater risks based on the estimated fractional radionuclide mass present.
b. GRAs to be evaluated include No Action; Institutional Controls; Containment (including capping); Treatment (in situ and ex situ); Retrieval; and Disposal.

5.8.8 References

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5.9 CPP-28

Site CPP-28 is associated with holes that were drilled in a waste line during construction. It is located a few yards south of Tank WM-181 (see Figure 1-2) and accounts for approximately 3.5% of the Cs-137 and Sr-90 activity in OU 3-14.

5.9.1 Description of Release

Site CPP-28 was discovered in October 1974 when drilling operations in connection with a cathodic protection system upgrade found contaminated soil beneath the surface of the tank farm. The CPP-28 contamination was the result of a construction error during the installation of waste transfer Line PUA-1005 in the 1950s and the use of an inferior secondary containment design around the line. An investigation report (Allied Chemical 1975) written after the contaminated soil was discovered details the cause, repair, costs, etc. of the leak.

5.9.1.1 Background of System Configuration and Leak. In 1955, a major expansion project at INTEC (known as the ICPP at the time) installed three new 300,000-gal storage tanks (WM-182, WM-183, and WM-184) and associated waste transfer lines in the tank farm. Portions of two transfer lines, PUA-1005 and PUA-1030, were equipped with a split steel encasement of inferior design. The encasement consisted of a lower trough section constructed of welded stainless steel in which the transfer line was supported. The upper, cover portion of the encasement was made of carbon-steel painted with two coats of bitumastic paint. The upper portion was lapped and pinned to the lower stainless-steel trough by means of screws spaced on 1-ft centers along each side of the encasement near the centerline of the waste transfer pipe (see Figure 5-19 and INTEC Drawing 105585, Rev. 3). The screws were inserted through holes that were drilled through the encasement after the transfer line and encasement were set in place in the field. The design called for the use of a stop when drilling the encasement pilot holes to prevent damage to the waste transfer pipe inside the encasement (see note on Figure 5-19). However, despite the cautionary notes in the system design, one of the encasement screw holes went through waste transfer pipe PUA-1005, leaving a hole in the line.

After the leak was discovered in 1974, the two lines with the split carbon/stainless-steel encasement were removed and replaced with a system having welded, stainless-steel, pipe-in-pipe encasement.

Although waste transfer line PUA-1005 had a hole for nearly 20 years of use, the soil contamination at CPP-28 likely occurred in the early 1970s, after the failure of the upper portion of the encasement. Soil contamination did not occur throughout the 20 years of service of the waste transfer line. The original contamination investigation report concluded leaks likely did not occur during most waste transfers. The waste transfer system was a low-flow, gravity-drain system that seldom filled the pipe above the level of the hole. Even if waste leaked from the primary waste transfer line, soil contamination did not occur immediately because the lower trough potion of the encasement was constructed of welded stainless steel and conducted any leakage to the sump of a nearby tank vault. Soil contamination did not occur until the upper, carbon-steel portion of the encasement failed, which allowed soil to enter the encasement and block the drainage path for the leaking liquid. This resulted in subsequent soil contamination. The upper portion of the encasement was not in direct contact with the leaking waste and was coated to prevent corrosion from the soil. It likely lasted many years before failing.

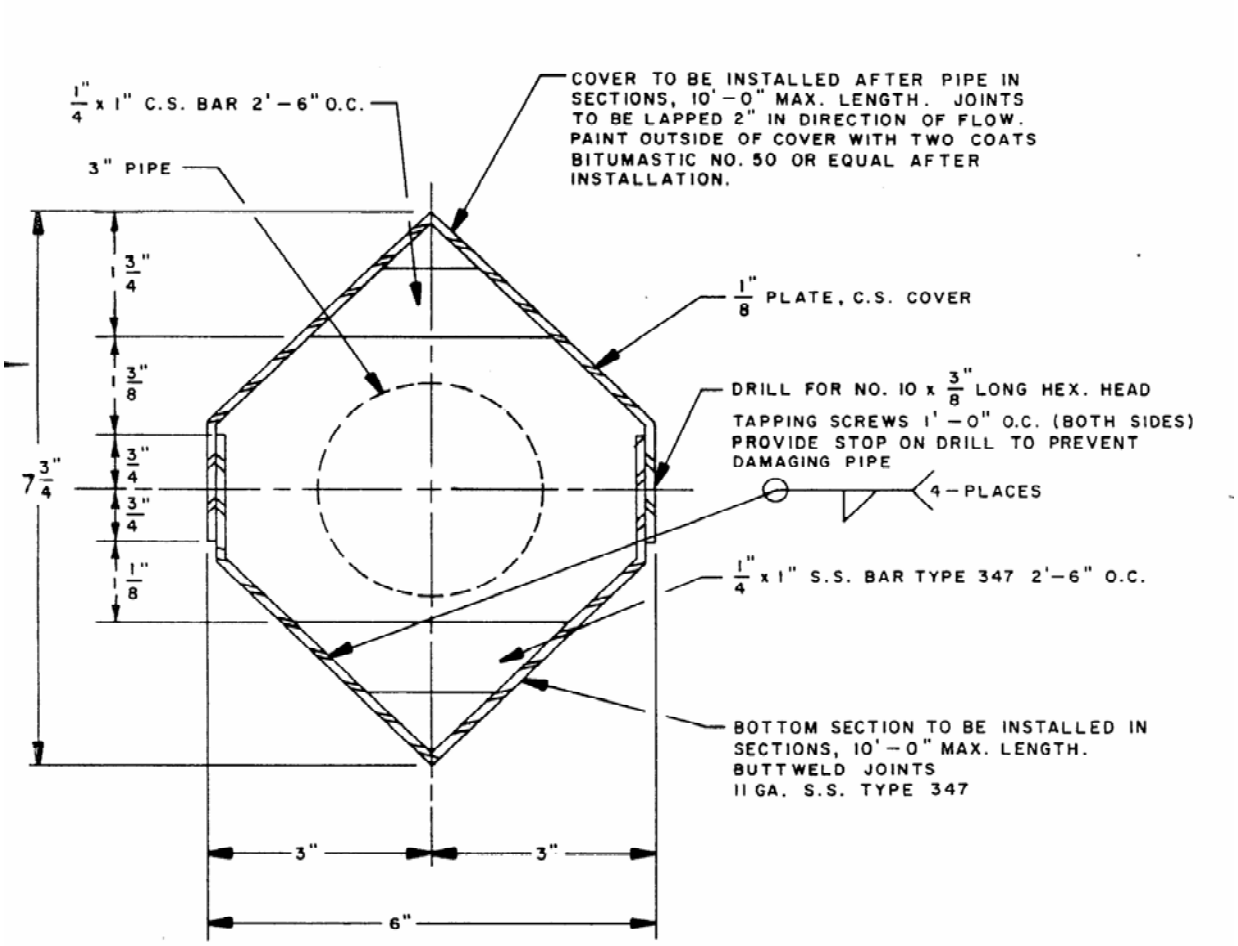

Figure 5-19. Cross section of the original (1955) design of Line 3"PUA 1005 with its split steel secondary encasement (taken from INTEC Drawing 105585, Rev. 3).

An assessment (Wenzel 2004) of the relative activities of radionuclides found in the contaminated soil shows the soil contamination occurred in the early 1970s (rather than throughout the history of the line). Soil analyses made at the time of the leak discovery found relatively large quantities of short-lived radionuclides such as Cs-134 (2-year half-life) and Ce-144 (0.8-year half-life) compared to long-lived radionuclides such as Cs-137 (30-year half-life). Had the leak occurred steadily over the 20-year history of the system, a large amount of long-lived radionuclides would have accumulated in the soil. Short-lived radionuclides would not have accumulated over an extended time period. Instead, short-lived radionuclides would have reached equilibrium, where the decay would have equaled the buildup, resulting in no net buildup. The approximate time and age of the leak can be determined by the ratios of long- and short-lived radionuclides and by comparison with the radionuclide content of tank farm wastes of various ages. Newly generated waste (and soil contaminated with such waste) has a small Cs-137/Cs-134 ratio. Old waste (and soil contaminated with such waste) has a large Cs-137/Cs-134 ratio due to the rapid decay of Cs-134 over time.

The correlation of waste age and radioisotope ratios is illustrated by several waste analyses from the approximate time the leak occurred. In autumn 1971, an extensive waste sampling effort was completed and the contents of three SBW and three first-cycle waste tanks were analyzed (Rhodes 1972). The first-cycle waste was "new" waste (generated from 1969 through 1971). The Cs-137/Cs-134 ratio of

the first-cycle wastes ranged from 3.4 to 6.9, averaging about 5. The low Cs-137/Cs-134 ratios were characteristic of "new" waste that contained relatively high Cs-134 activity.

The SBW sampled in 1971 had been generated slowly over time and therefore contained a mixture of both new and old wastes (up to 20 years old). The Cs-137/Cs-134 ratio of the SBW ranged from 54 to 467, averaging 252. The highest Cs-137/Cs-134 ratio (nearly 500) was in the oldest waste and was characteristic of waste generated in the 1950s. The SBW with the Cs-137/Cs-134 ratio of 54 contained new SBW mixed with old SBW. Had the CPP-28 soil contamination occurred over an extended period of time, it would have contained both old and new wastes and the Cs-137/Cs-134 ratio in the contaminated soil would have been high, similar to that of the SBW.

The Cs-137/Cs-134 ratio in the CPP-28 soil was 8.7, approximately the same as the first-cycle waste generated in the early 1970s. If one decays the lowest first-cycle waste Cs-137/Cs-134 ratio (3.4) from the 1971 analyses for 3 years to the leak discovery date in the autumn of 1974, the Cs-137/Cs-134 ratio is 8.8, virtually identical to the value of 8.7 in the contaminated soil. The low Cs-137/Cs-134 ratio in the contaminated soil indicates the leak was from recently (at the time) generated waste. Thus, although there was a hole in PUA-1005 for nearly 20 years, soil contamination did not occur until the secondary containment failed in the early 1970s.

5.9.1.2 Waste Source Term. The waste that leaked from the hole in Line PUA-1005 and contaminated CPP-28 was first-cycle raffinate generated in the early 1970s. During that time, most of the first-cycle waste came from either the dissolution of zirconium-clad fuels or the simultaneous dissolution of both zirconium and aluminum-clad fuels (coprocessing). A small amount of waste came from the dissolution of stainless-steel-clad fuel in 1973, and a very small amount came from the dissolution of aluminum-clad fuel (not coprocessing). Rhodes (1972) provides detailed chemical and radionuclide data for two tanks of first-cycle zirconium waste (WM-187 and -188) and a tank of coprocessing waste (WM-185) generated in the early 1970s. Swenson (1994) gives the composition of a mixture of aluminum and stainless-steel waste (WM-183) from that era. Wenzel (2004) concluded coprocessing waste was the most likely type of waste leaked at CPP-28, based on the relative activities of the nuclides in the soil, and provides a detailed radiological source term for that waste, including estimates for radionuclides not included in the 1971 waste analyses.

The 1971 sample data (Rhodes 1972) do not include the I-129 or Tc-99 activity in the wastes. These radionuclides were typically not included in tank farm waste analyses because their activities were so low they were difficult to detect. However, other historical tank farm data indicate there was no measurable partitioning of Tc-99 from Cs-137 and other fission products in the fuel dissolution/first-cycle extraction process. Therefore, the Tc-99 activity in first-cycle waste was about the same as that calculated by fission yield in reactor fuel. Wenzel (2004) provides a value of the Tc-99 activity based upon fission yield.

Studies (McManus 1982) have shown that some (15%) of the I-129 originally in the SNF volatilized in the fuel dissolution process or was separated from the bulk of the fission products during first-cycle uranium extraction. As a result, about 85% of the fission product I-129 remained in the first-cycle raffinate. Wenzel (2004) applied this factor to the fission-yield I-129 activity to obtain a more refined value for the I-129 activity in the first-cycle raffinate.

The tritium (H-3) activity in the waste that leaked is less certain than other radionuclides. The relative activities of most fission products, such as Cs-137 and Sr-90, were the same (when corrected for age) in all types of tank farm waste. However, the tritium activity varied significantly among Zr, Al, and coprocessing wastes. This was the result of the fuel dissolution process. The dissolution of Zr-clad fuel generated large amounts of hydrogen gas that left the process via the off-gas system. Most (as much as

90%) of the tritium in the Zr-clad fuel left the dissolver as hydrogen gas and was not part of the liquid waste. The Al (and stainless-steel-clad) fuel dissolution process generated only small amounts of hydrogen gas. Consequently, most of the tritium in the Al (and stainless-steel-clad) fuel remained in the first-cycle raffinate. Coprocessing waste was a mixture of tritium-depleted Zr and tritium-bearing Al wastes and had about 50% of its theoretical tritium activity. Wenzel (2004) used the 1971 coprocessing sample data for the activity of tritium. That is a reasonable value for coprocessing waste. However, the activity of H-3 in the waste that leaked could vary depending on the amount of the waste derived from Al or Zr fuel reprocessing. The tank farm groundwater model could adjust the tritium by a factor ranging from two higher to five lower than the value in Wenzel (2004) and have a H-3 activity resulting from varying the amounts of Al and Zr reprocessing raffinates in the coprocessing waste, age of fuels reprocessed, etc.

The nitrate content of the Zr and coprocessing wastes was similar (about 2.4M) as shown by the data in Rhodes (1972). The nitrate content of the Al (and stainless-steel) waste was higher than that of Zr waste, as illustrated by the 4.2 M value in the WM-183 waste in Swenson (1994). The WM-183 waste was a mixture of Al and stainless-steel raffinates. The nitrate content of Al fuel raffinate was a little higher (4.5M) and that of stainless-steel raffinate was a little lower (3.5M) than the mixture in WM-183 (4.2M).

5.9.1.3 Waste Volume Leaked to Soil. The exact amount of waste that leaked into the soil is not known. The original investigation committee estimated 120 gal of waste leaked to the soil by assuming the activity of the waste was 50 Ci/gal. However, the use of 50 Ci/gal appears to have been conservatively high. Its use likely underestimated the volume of waste that leaked into the soil and overestimated the activity remaining in the soil after much of the contamination was removed when the line was repaired in 1974. The value of 50 Ci/gal was typical of first-cycle fuel reprocessing waste generated in the late 1950s, when the line with the hole was initially installed. In the 1950s, Al-clad fuel was processed after a relatively short cooling time (a few weeks) and first-cycle raffinate was concentrated in an evaporator. Much of the radioactivity in the waste was due to short-lived elements such as Ce-144. Such waste had an activity of about 50 Ci/gal and was likely the basis of the estimate in the original investigation report.

By the early 1970s (when the CPP-28 soil contamination occurred), fuel cooling time prior to reprocessing had increased, and most first-cycle wastes were no longer concentrated in an evaporator because they contained the corrosive fluoride ion. As a result, the activity of first-cycle waste in the early 1970s was less than 50 Ci/gal. The first-cycle waste generated in the early 1970s had an average Cs-137 activity of about 3 Ci/gal (Rhodes 1972). The activities of Ba-137m, Sr-90, and Y-90 in the waste were each about the same as the activity of Cs-137. Analyses of the contaminated soil found the combined Ce-144/Pr-144 activity was about twice that of Cs-137. Therefore, the activity of the Ce-144 alone was about the same as the Cs-137. This is consistent with the first-cycle waste analyses from the early 1970s. The total activity of the liquid waste that contaminated CPP-28 was likely about 18 Ci/gal (sum of 3 Ci/gal each for Cs-137, Ba-137m, Sr-90, Y-90, Ce-144, and Pr-144) instead of the 50 Ci/gal used in the leak investigation report. Other radionuclides had relatively insignificant activities (less than 5%) in terms of the total curie content of the waste.

Much of the contaminated soil was removed and loaded into dumpsters in 1974 when the line was excavated and repaired. Based on soil sample analyses and dumpster radiation readings, a total of 3,000 Ci of activity was determined to have been removed from the tank farm and loaded into the dumpsters. The investigation committee concluded this corresponded to 60 gal of waste (3,000 Ci divided by 50 Ci/gal). However, if one assumes the waste activity was only 18 Ci/gal, 3,000 Ci corresponds to 167 gal of waste (3,000 Ci divided by 18 Ci/gal) that leaked and was removed. The investigation report calculated the liquid content of the contaminated soil left in place as 60 gal, based upon the estimated

volume of contaminated soil and the liquid content of the soil. The report then concluded 3,000 Ci of activity were left in place (60 gal multiplied by 50 Ci/gal in the waste). However, if one assumes the waste contained only 18 Ci/gal, 60 gal of waste corresponds to 1,080 Ci of activity (60 gal multiplied by 18 Ci/gal) that were left in place.

Using an activity of 18 Ci/gal yields 227 gal of waste (167 removed and 60 left behind) leaked to the soil, nearly double the original estimate of 120 gal. A waste activity of 18 Ci/gal means 1,080 Ci of activity were left in the tank farm soil, which is only 36% of the estimate of 3,000 Ci in the investigation report. The higher waste volume (227 gal) and lower activity (about 18 Ci/gal) is a better estimate of the waste that leaked at CPP-28.

5.9.1.4 Source Term Summary. Site CPP-28 was contaminated by first-cycle raffinate that leaked from Line PUA-1005. The waste was most likely first-cycle coprocessing raffinate generated in the early 1970s. Wenzel (2004) provides a radionuclide source term for that type of waste. The amount of waste that leaked is not known and must be estimated. The original leak investigation reported 120 gal of waste leaked, based on an activity of 50 Ci/gal in the waste. The value of 50 Ci/gal was valid for 1950s and early 1960s wastes, but that value is too high for early 1970s waste and is not supported by the isotopic signature of the contaminated soil. The average activity of early 1970s waste was about 18 Ci/gal. The use of a lower-activity waste increases the estimate of the total amount of waste that leaked to about 230 gal. However, it decreases the estimate of the activity left behind in the soil. Allied Chemical (1975) does not contain data for Tc-99 or I-129. The activity of those nuclides in the waste was estimated in Wenzel (2004). The tritium source term was also estimated in Wenzel (2004) but could vary depending on the type of waste assumed to have leaked.

Table 5-26 summarizes the activity of major radionuclides and mass of nitrate released at Site CPP-28, assuming 230 gal of waste with 3 Ci/gal Cs-137 and 2.4 molar nitrate were released.

5.9.2 Cleanup

During the 1974 excavation activities, clean soil was stockpiled while contaminated soil was loaded into special containers for disposal at the RWMC. Soil with radiation readings up to 75 R/hr gross beta-gamma was encountered at depths less than 2 ft beneath the encasement. Efforts to excavate to depths below the encasement in the central zone of contaminated soil were abandoned because of handling and exposure problems. A total of 56 yd^3 of contaminated soil containing an estimated 3,000 Ci of gross radionuclides was removed from the release site, as described previously.

During the 1993 to 1996 tank farm upgrades, portions of Sites CPP-28, -20, -25, and -79 were excavated. Excavation depths ranged from 0 to 35 ft bgs, with most being completed at approximately 15 ft bgs. Field beta/gamma radiation measurements encountered during excavation ranged from 0 to 5 R/hr. No contaminated soils were reported removed from this site during the construction work.

Table 5-26. Estimate of major radionuclides and nitrate released at Site CPP-28 in 230 gal of waste.

Cs-137	Sr-90	H-3	Tc-99	I-129	NO_3
690 Ci	660 Ci	0.56 Ci	0.11 Ci	1.5E-04 Ci	130 kg

5.9.3 Previous Investigations

On October 1, 1974, during the course of drilling operations in connection with an upgrade construction project for the INTEC cathodic protection system, contaminated soil was encountered at a location point identified as Anode 1-42. The hole being drilled for an anode encountered contaminated soil with contact radiation levels of 1 R/hr at 6 ft bgs; this hole is located 10 ft south of the concrete vault that houses liquid waste storage tank WM-181 and approximately 5 ft north of waste transfer line 3"PUA-1005 used to transfer first-cycle raffinates (Figure 5-20). The borehole was advanced on October 2, 1974, to a depth of 10 ft, and soil samples were collected for analysis. Results of the sample analysis indicated Cs-137, Ru-106, Ce-144, and Sr-90 were the primary isotopes. Unfortunately, analytical data sheets for these samples could not be located to provide actual radionuclide activities or the suite of analytes tested for.

To help determine the nature and extent of contaminated soil, six soil borings were drilled on October 10, 1974. Soil samples were collected from the bottom of each hole, ranging in depth from 6.5 to 10 ft bgs. The boreholes are designated as BH-1 through -5 and BH-7. Contamination was encountered in only one of the six holes drilled (Table 5-27). Hole #4 encountered contaminated soil readings of up to 35 R/hr beta-gamma at contact. No isotopic analyses were performed on any of the soil samples. On the basis of the beta-gamma readings, some type of waste release was believed to have occurred.

On October 17, 1974, a review team was appointed by Allied Chemical, Idaho Chemical Programs Operations Office Management, to evaluate the consequence, determine the release mechanism, and define the extent of the contaminated soil body. In order to accomplish its primary mission, the review team initiated immediate trenching operations to permit inspection of the 3"PUA-1005 waste transfer line in the area of soil contamination, permit inspection of diversion Valve Boxes A-3A and A-3B, and plan for the installation of additional soil borings to determine the extent of soil contamination.

Trenching operations were started on October 22, 1974, beginning at the intersection of an underground electrical duct near Junction Box No. 3, approximately 25 ft west of Anode 1-42, and working eastward directly above Line 3"PUA-1005 (Figure 5-20). A lap joint in the encasement was uncovered and inspected approximately 10 ft west of Anode 1-42. This inspection revealed a 1.5-in. separation at the lap joint and a longitudinal joint separation of several feet where the tapping screws had corroded. The inside of the encasement in the region of joint separation was partially filled with soil. At that point in the investigation, several holes were hand-augered to depths of 3 ft below the encasement with no indication of soil contamination.

Contaminated soil was first encountered during the trenching operations approximately 3 ft west of Anode 1-42. This soil was believed to have been brought up during the augering of the exploratory test holes. Trenching continued eastward approximately 10 ft past the zone of contamination. A second encasement lap joint was encountered approximately due south of Anode 1-42. Inspection of the joint revealed a greater degree of deterioration than with the first joint uncovered. A section of the upper carbon-steel cover approximately 1 ft long appeared to be severely corroded (presumably from contact with an acidic waste solution) and had some inward collapse.

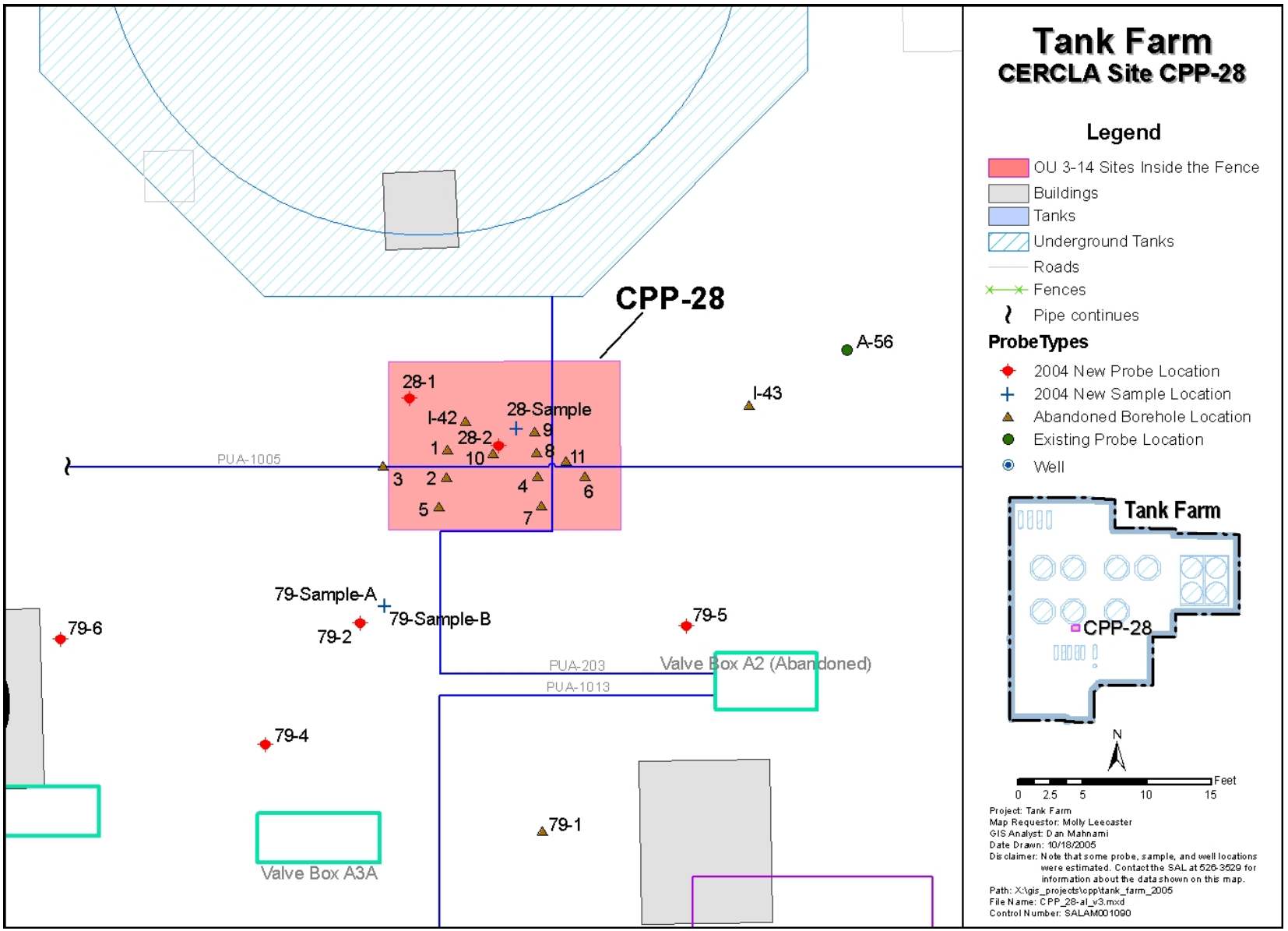

Figure 5-20. CPP-28 detailed map.

Table 5-27. 1974 test hole radiation readings for CPP-28 (R/hr).[a, b, c]

Depth	Test Hole #1	Test Hole #2	Test Hole #3	Test Hole #4	Test Hole #5	Test Hole #6	Test Hole #7	Test Hole #8	Test Hole #9	Test Hole #10	Test Hole #11
0.0	—	—	—	—	0.030	—	—	—	—	—	—
1.0	0.035	—	—	—	0.030	0.025	0.020	0.040	0.010	0.040	0.040
2.0	0.035	0.050	0.025	0.060	0.050	0.030	0.015	0.050	0.040	0.040	0.040
3.0	0.035	0.050	0.025	0.070	0.060	0.035	0.006	0.070	0.040	0.040	0.050
4.0	0.035	0.050	0.025	0.100	0.060	0.070	0.002	0.080	0.040	0.050	0.060
5.0	0.030	0.050	0.025	0.150	0.070	0.200	0.003	0.100	0.040	0.060	0.050
6.0	0.007	0.200	0.018	0.200	0.060	0.250	0.010	0.350	0.012	0.090	0.150
6.5	—	—	—	1.50	—	—	—	2.00	—	—	—
7.0	0.007	1.500	0.003	5.50	0.100	0.150	0.010	7.00	0.008	0.350	5.00
7.5	—	—	—	35.00	—	—	—	12.00	—	—	—
8.0	0.007	0.300	0.002	20.00	2.00	0.040	0.010	90.00	0.008	11.00	11.00
8.5	—	—	—	3.00	—	—	—	65.00	—	50.00	—
9.0	0.050	0.060	0.001	0.800	0.050	0.020	0.050	10.00	0.006	4.00	0.250
9.5	—	—	—	—	—	—	—	1.00	—	—	—
10.0	0.040	0.005	0.0006	0.100	0.020	0.004	0.250	0.012	—	0.050	0.010
11.0	0.020	0.005	0.0005	0.010	0.050	0.001	0.050	0.004	<0.005	0.007	0.002
12.0	0.010	0.0015	<0.0005	0.006	0.050	<0.001	0.012	0.002	—	0.001	<0.001
13.0	0.010	0.001		0.003	0.060			0.001	<0.001	<0.001	
14.0		<0.0005		0.002	0.002			<0.001			
15.0				0.001	0.001						

a. — indicates radiation level was not measured.
b. Values in bold red indicate radiation levels equal to, or greater than, 1.0 R/hr.
c. Shading indicates the elevation of the waste transfer line 3"PUA-1005.

During excavation activities, clean soil was stockpiled while contaminated soil was loaded into special containers for disposal at the RWMC. Soil with radiation readings up to 75 R/hr gross beta-gamma was encountered at depths less than 2 ft beneath the encasement. Efforts to excavate to depths below the encasement in the central zone of contaminated soil were abandoned because of handling and exposure problems.

After trenching operations were completed, monitoring test pipes were driven into the ground using a cable crane rig outfitted with a 750-lb drive shoe (Figure 5-21). Test pipes were driven in 11 locations adjacent to the pipeline encasement and in the area of soil contamination to depths up to 20 ft, as shown in Figure 5-21. After each test pipe was driven, a radiation-detection probe was lowered into the test pipe, and radiation readings were measured at specific depth intervals. Recorded radiation readings collected from the test pipes are presented in Table 5-27.

On December 3, 1974, work began to cut, remove, and inspect the 20-ft section of the waste transfer line to determine the cause of the contamination. After removal of the pipe section, a cursory inspection revealed a 1/8-in.-diameter drill hole in the side of the 3-in. stainless-steel pipe (Figure 5-22). After closer inspection, the hole in the pipe was determined to be 10 ft, 7 in. from the east pipe cut and oriented 90 degrees from the top of the pipe on the south side as originally installed. This location

Figure 5-21. Test pipes being driven into the ground during the contaminant release investigation in 1974 at CPP-28.

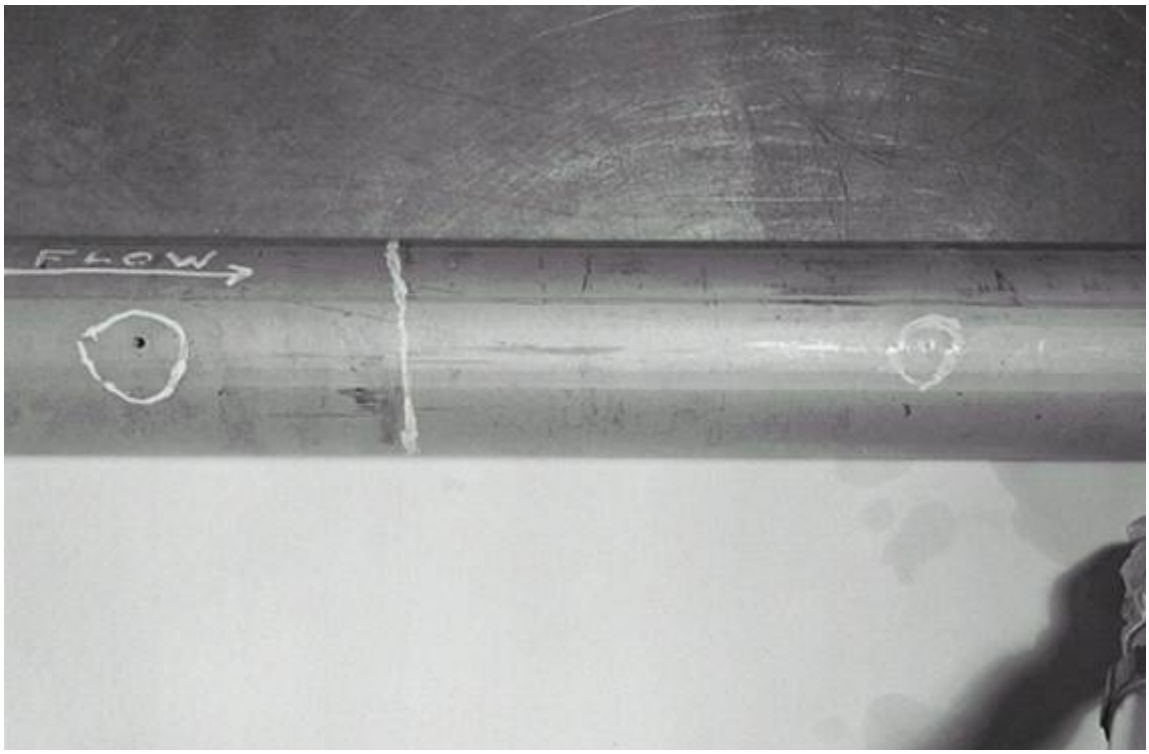

Figure 5-22. Drill hole found in waste transfer line 3"PUA-1005 at CPP-28.

corresponded closely with the location of the corroded area of the upper section of carbon-steel encasement observed in the field. The hole penetrated completely through the pipe wall, and small indents 40 to 50 mils deep existed along the pipe on 1-ft centers eastward from the hole. No holes or indents were found on the opposite (north) side of the pipe. The hole and indents were consistent with the stitch screw spacing used to hold the top cover of the encasement to the bottom trough. A metallurgical inspection indicated that the pipe suffered very little corrosion damage during its 18 years of intermittent service and that the failure was strictly due to a hole that had existed when it was inadvertently drilled into the waste line during construction from 1955 to 1956.

From the data provided by the 11 test pipes, the zone of soil contamination was estimated to be approximately 9 ft in diameter by 2 to 3 ft in average depth below the pipe encasement at a depth of 7 ft bgs (Figures 5-23, 5-24, and 5-25). As described previously, calculations made during the investigation estimated that approximately 128 ft^3 of contaminated soil existed at the site and the amount of contamination remaining was around 3,000 Ci.

During the 1992 Track 2 investigation, an attempt was made to locate the 11 test pipes so that additional subsurface radiation readings could be collected. The new measurements were intended to update gamma readings in the test pipes and help determine if contaminant migration had occurred since the 1974 investigation. An area measuring 7 by 10 ft was excavated to a depth of 7 ft in an attempt to find the test pipes. The excavation location was selected based on historical photographs, plant drawings, and results of surface geophysical surveys. The test pipes were not found during the excavation activities, and subsequent evaluation determined that the excavation was located too far to the west, missing the test pipe locations. Therefore, it is uncertain whether the test pipes still exist at the site.

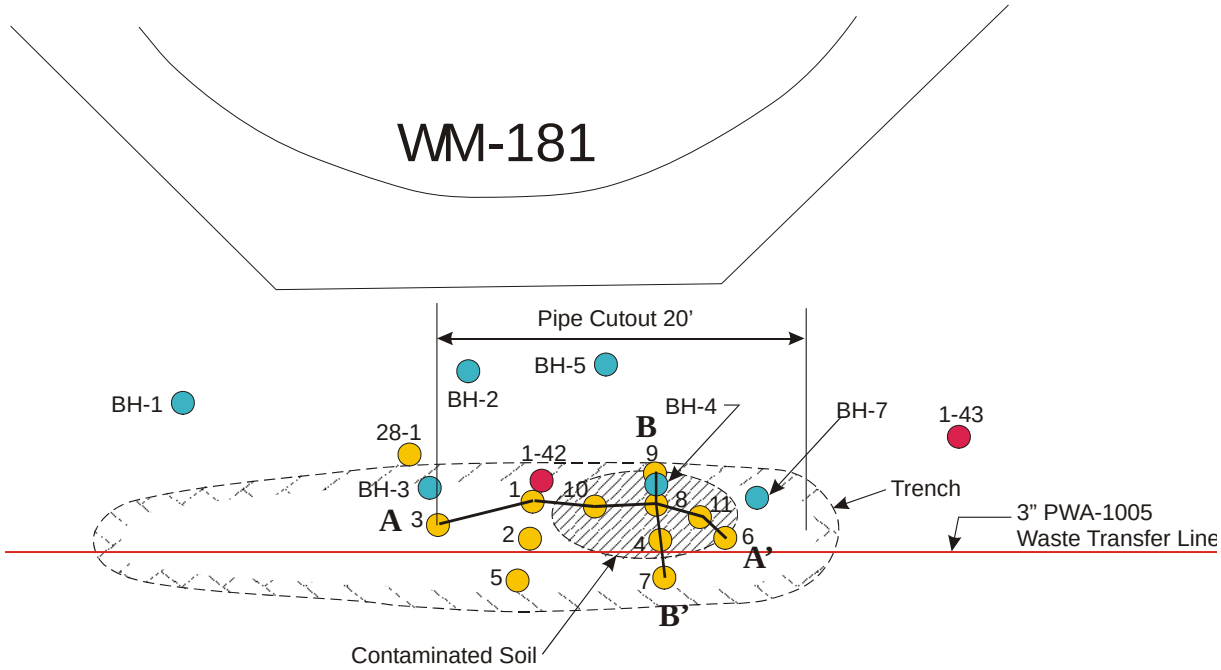

Figure 5-23. CPP-28 fence diagram location map.

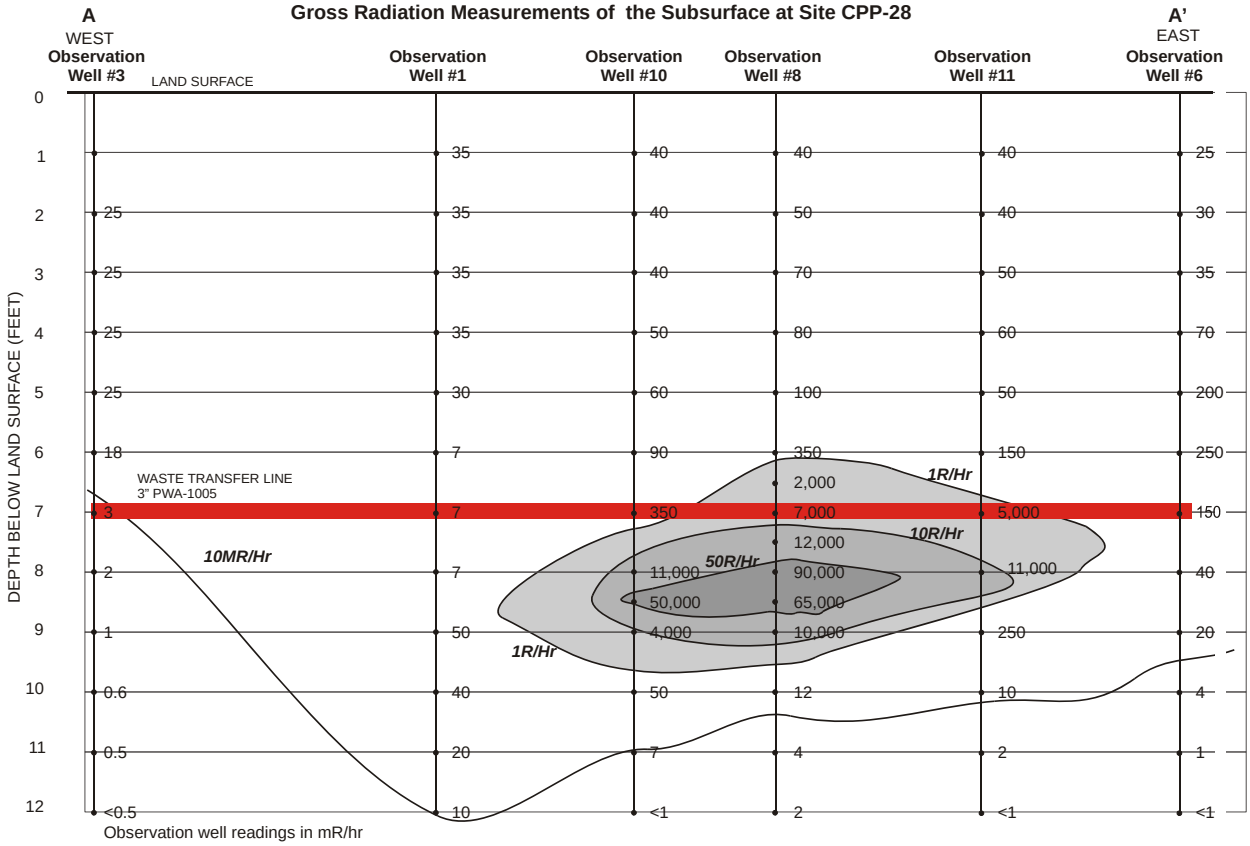

Figure 5-24. East-west fence diagram through the contaminated soil zone at CPP-28.

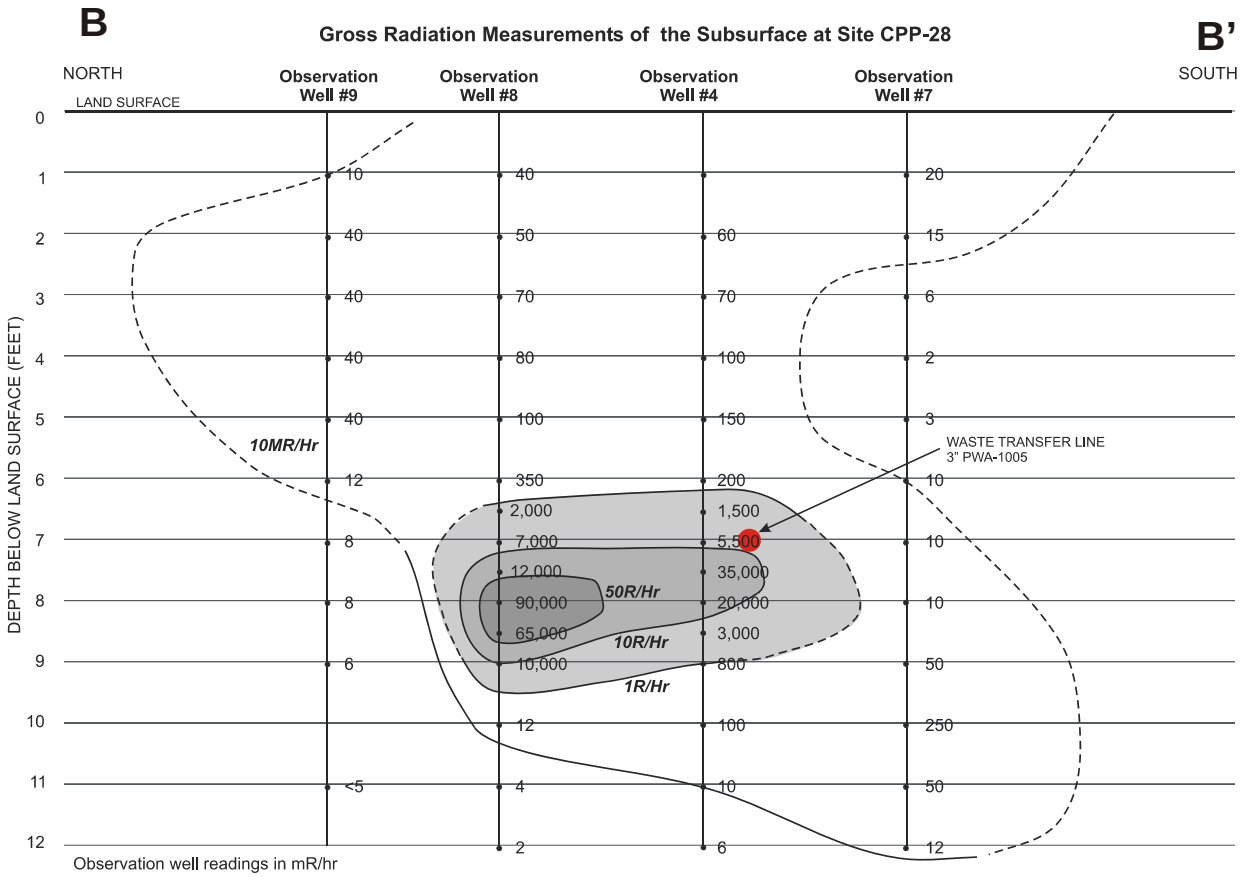

Figure 5-25. North-south fence diagram through the contaminated soil zone at CPP-28.

5.9.4 OU 3-14 Investigation

5.9.4.1 Scope. The OU 3-14 field investigation was focused on resolving remaining data gaps for CPP-28 described below. Details of the OU 3-14 field investigation at CPP-28 are provided in Appendix H. These include

- Sample collection procedures
- Sample documentation, custody, handling, and transportation
- Analytical methods
- Data reporting
- Quality control.

Details of the location and installation of gamma-logging probeholes and sampling coreholes are provided in Appendix F.

5.9.4.2 DQOs. DQOs for the OU 3-14 field investigation for CPP-28 are summarized in Table D-7 of DOE-ID (2004). The composition of contamination was considered inadequate to complete the BRA and FS, since concentrations of all COPCs, including Tc-99 and I-129 and RCRA metals and organics,

had not been determined either through process knowledge or sampling and analysis. Process knowledge of the Tc-99 and I-129 present in the release was subsequently improved as described in Section 5.9.1.

The field investigation strategy formulated to obtain the decision inputs needed to resolve the decision statements included

- One corehole to basalt in the hotspot, sampling and analysis for the COPCs listed in Table 5-6, and archiving of excess sample material for possible subsequent K_d or treatability studies.

Probehole installation is described in Appendix F. Samples were collected in 4-ft intervals in core barrels using GeoProbe direct-push tooling and analyzed for the constituent list shown in Table 5-6. Results are summarized in Table 5-28 below and are provided in total in Appendix G. Casing was installed and the hole was gamma-logged using the AMP-50. Gamma readings for each depth interval are listed in Table A-1 of Appendix F.

5.9.4.3 Probing and Gamma Logging Investigation. Probehole installation is described in Appendix F. Probehole locations are shown on Figure 5-20. Probehole CPP-28-1 (CPP-1876) was hand-augered to a depth of 9 ft bgs to prevent damage to infrastructure. Samples were collected from the hand-augered interval. Casing was then installed to a depth of 49.7 ft bgs using direct-push equipment. The annular space between the hand-augered portion of the probehole and the casing was filled with bentonite crumbles.

Probehole CPP-28-1 (CPP-1876) was gamma-logged using both the AMP-50 and AMP-100. Gamma-logging results are shown in Appendix F. Gamma-logging results for the hand-augered portion of the probehole may not be representative of the in situ conditions due to the presence of bentonite. AMP-100 data were collected before addition of bentonite, and AMP-50 data were collected after.

Probehole CPP-28-2 (CPP-1877) was hand-augered to a depth of 10 ft bgs. Casing was then installed to a depth of 54.2 ft bgs using direct-push equipment. The annular space between the hand-augered portion of the probehole and the casing was filled with bentonite crumbles. The probehole was gamma-logged using the AMP-50 and AMP-100.

Probehole CPP-28-Sample (CPP-1878) was located adjacent to CPP-28-2. The probehole was hand-augered to 10 ft bgs, then completed with casing to 54 ft bgs using direct-push equipment. Samples were collected in 4-ft intervals in core barrels from the bottom of the hand-augered hole to basalt and analyzed for the constituent list shown in Table 5-6. Results are discussed below and are provided in total in Appendix G.

5.9.4.4 Results. OU 3-14 field investigation sampling results are summarized in Table 5-28 and in Table A-1 of Appendix F. Table 5-28 includes only a subset of analytical results and does not include laboratory or validation flags, sampling errors, or MDL; "ND" represents compounds that were U- or UJ-flagged; and "0" represents compounds detected at low levels but the decimal places are not shown. Complete detailed sampling results are provided in Appendix G. Elevated gamma readings (greater than 1 mR/h) of 2.96 and 2.3 mR/h were observed from 11 to 12 ft bgs in Borehole CPP-28-1 (CPP-1876). Gamma readings again increased to a maximum of 2,730 mR/h between 28.5 and 36.5 ft bgs.

Table 5-28. Summary of analytical results for CPP-28-sample.

Depth (ft)	Cs-137 (pCi/g)	Sr-90 (pCi/g)	Pu-238 (pCi/g)	Pu-239/240 (pCi/g)	I-129 (pCi/g)	Tc-99 (pCi/g)	Nitrate-N (mg/kg)	Hg (mg/kg)	Am-241 (pCi/g)	Eu-154 (pCi/g)	U-233/234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Np-237 (pCi/g)	pH	H-3 (pCi/g)	Pu-241 (pCi/g)	Fluoride (mg/kg)	Zirconium (mg/kg)
2-3	1,070	78	0[a]	0	ND[b]	ND	4	0.05	0	1	1	0	0	ND	9.2	ND	—[c]	—	—
6-7	217	34	0	0	ND	3	2	0.04	0	0	1	0	1	ND	9.3	ND	—	—	—
8-12	1,180	32,600	6	0	ND	16	1	0.01	R[d]	176	1	ND	1	ND	9.0	ND	7	ND	18
12-16	1	21,600	ND	ND	ND	100	1	0.01	ND	ND	1	0	1	ND	8.8	ND	—	—	—
16-20	3	3,040	ND	0	ND	4	ND	0.02	ND	ND	1	0	1	ND	9.0	ND	—	—	—
20-24	0	3,950	ND	ND	ND	4	1	0.07	0	ND	1	0	1	ND	9.1	ND	—	—	—
20-24	1	2,460	ND	0	ND	3	1	0.08	0	ND	1	0	1	ND	9.1	ND	—	—	—
24-28	3	56	0	0	ND	3	1	0.01	ND	ND	0	ND	0	ND	9.2	ND	—	—	—
28-32	2,540,000	223,000	12,600	8,160	ND	196	1	0.46	2,000	3,770	270	ND	ND	33	8.8	ND	13,700	5	17
32-36	110	379,000	0	0	ND	40	1	0.09	0	ND	1	0	1	ND	8.5	ND	—	—	—
36-40	1	1,950	ND	ND	ND	3	ND	ND	ND	ND	1	0	1	ND	9.2	ND	—	—	—
40-44	1	95	ND	ND	ND	7	ND	0.02	ND	ND	1	0	1	ND	9.1	ND	—	—	—
44-48	4	19	ND	ND	ND	5	1	ND	0	ND	1	0	1	ND	9.2	ND	—	—	—
48-52	2	18,000	0	ND	ND	2	1	0.02	ND	ND	1	ND	1	ND	9.4	ND	—	—	—
52-56	1	85,200	ND	ND	ND	3	1	0.02	ND	ND	1	0	1	ND	9.2	ND	2	ND	19

a. 0 = detected at low levels less than 0.05; decimal places not shown.
b. ND = nondetect (U) or false positive (UJ).
c. — = not analyzed.
d. R = rejected data.
Note: for uncertainty, laboratory and validation flags, etc., see Appendix G.

Similarly, elevated gamma readings with a maximum of 13.7 mR/h were encountered in Probehole CPP-28-2 (CPP-1877) between 10 and 12.5 ft bgs. Gamma readings again increased to a maximum of 2,330 mR/h at a depth of 30.5 ft bgs.

Sampling results for CPP-28-sample (CPP-1878) indicate elevated Cs-137 concentrations from 2 to 12 ft bgs, with a maximum of 1,180 pCi/g at 8-12 ft bgs. Concentrations again increase to 2,540,000 pCi/g at 28-32 ft bgs, coincident with the maximum gamma reading in adjacent probehole CPP-28-2. Elevated Sr-90 concentrations occur throughout the soil profile from 2-56 ft and generally occur with elevated Cs-137. A maximum concentration of 379,000 pCi/g was detected at 32-36 ft bgs.

Pu-238 and -239/240 were detected only in the 28- to 32-ft interval at concentrations of 12,600 and 8,160 pCi/g, respectively. Tc-99 was detected at a maximum concentration of 196 pCi/g in the 28- to 32-ft bgs interval. I-129 was not detected.

Concentrations of INTEC liquid waste system listed RCRA constituents cited in INEEL (1999) are provided in Appendix G. Toluene was the only INTEC liquid waste system listed RCRA constituent analyzed for that was detected; it was detected at a maximum concentration of 376 µg/kg in the 2- to 3-ft bgs interval.

5.9.5 Contamination Remaining in Alluvium

Much of the contamination at this site was removed, as discussed previously. Contamination remaining in the alluvium at CPP-28 is distributed in two distinct zones. Contamination first appears at about 10-12 ft bgs and is likely due to the original CPP-28 release of first-cycle raffinate from PUA-1005 at 7 ft bgs, and the subsequent excavation and backfilling of some of the contaminated soil. Deeper contamination from the CPP-79 (deep) release is discussed in Section 5.17.

5.9.5.1 Nature of Contamination. The nature of contamination at CPP-28 is consistent with the conceptual model of the release of first-cycle raffinate as discussed previously.

5.9.5.2 Vertical Extent. The vertical extent of contamination from the original CPP-28 release appears to be confined to an interval from about 6 to 12 ft bgs. Contamination in this interval has been partially removed. Shallow contamination from 0-6 ft remains due to use of contaminated backfill in previous excavations, as evidenced by concentrations of Cs-137 of 1,070 pCi/g at 2-3 ft as shown in Table 5-28. Vertical extent of contamination in the deeper interval at 28-32 ft bgs is discussed in Section 5.17.

5.9.5.3 Areal Extent. The areal extent of contamination appears to be conservatively defined by the original release investigation, as depicted in Figures 5-24 and 5-25.

5.9.5.4 Remaining Curies. About 1,080 Ci of total activity are estimated to have been left in the alluvium resulting from the CPP-28 release as discussed previously. The deeper contamination at about 28-32 ft bgs is discussed in detail in Section 5.17.

5.9.6 Uncertainties/Data Gaps

No significant data gaps remain for this site. The extent, distribution, and composition of contamination originally released and remaining are adequately known to complete the BRA and FS. Table 5-29 summarizes resolution of data gaps for CPP-28.

Table 5-29. Summary of data gaps for Site CPP-28.

Decision Statements	Extent Known Adequately to Resolve Decision Statement?	Distribution Known Adequately to Resolve Decision Statement?	Composition Known Adequately to Resolve Decision Statement?	Properties[a] Known Adequately to Resolve Decision Statement?
1. Determine whether or not soil exposure risks to future workers at CPP-28 exceed allowable levels, requiring control of the exposure pathway.	Yes. Incorporated into soils inside tank farm boundary (Section 5.18).	Yes. Incorporated into soils inside tank farm boundary (Section 5.18).	Yes. Contaminant composition consistent with conceptual model of release.	Properties information is not needed to resolve Decision Statement 1.
2. Determine whether or not contaminants are transported out of the tank farm soils to the SRPA at rates sufficient to result in COPC concentrations exceeding allowable levels at the exposure point, requiring control of the exposure pathway.	Yes. Source term conservatively estimated.	Yes.	Yes. Contaminant composition consistent with conceptual model of release.	Yes.
3. Determine whether or not a remedial action that includes [GRA][b] best meets FS evaluation criteria to mitigate excess risks, relative to other alternatives.	Yes.	Yes.	Yes. Contaminant composition consistent with conceptual model of release.	Yes.

a. Properties refer to physicochemical parameters for fate and transport modeling of groundwater contamination source term and parameters needed to evaluate in situ or ex situ treatment for release sites that present significant risks to groundwater. Knowledge of properties is not needed for sites that do not pose significant groundwater risks based on the estimated fractional radionuclide mass present.
b. GRAs to be evaluated include No Action, Institutional Controls, Containment (including capping), Treatment (in situ and ex situ), Retrieval, and Disposal.

5.9.7 References

Allied Chemical, 1975, *ICPP Tank Farm Contaminated Soil Incident October 1, 1974, Part I, Investigation*, Document ID 27171, Alternate ID 001061, Allied Chemical Corporation, March 1, 1975.

DOE-ID, 2004, *Operable Unit 3-14 Tank Farm Soil and Groundwater Remedial Investigation/ Feasibility Study Work Plan*, DOE/ID-10676, Rev. 1, U.S. Department of Energy Idaho Operations Office, June 2004.

INEEL, 1999, *A Regulatory Analysis and Reassessment of U.S. Environmental Protection Agency Listed Hazardous Waste Numbers for Applicability to the INTEC Liquid Waste System*, INEEL/EXT-98-01213, Rev. 1, Idaho National Engineering and Environmental Laboratory, February 1999.

McManus, G. J., F. A. Duce, S. J. Fernandez, and L. P. Murphy, 1982, *A Model of Iodine-129 Process Distributions in a Nuclear Fuel Reprocessing Plant*, ENICO-1108, Exxon Nuclear Idaho Company, April 1982.

Rhodes, D. W., Allied Chemical Corporation, to Distribution, August 7, 1972, "Composition of First- and Second-Cycle Wastes," Rhod-4-72.

Swenson, M. C., WINCO, to M. D. Staiger, WINCO, May 25, 1994, "Historical Tank Farm/WCF Campaign 6 Waste Analyses," MCS-07-94.

Wenzel, D. R., 2004, "Assessment of Radioactivity in INTEC Soil Contamination Site CPP-28," EDF-5318, Rev. 0, Idaho Completion Project, Idaho National Engineering and Environmental Laboratory, November 2004.

5.10 CPP-30

Site CPP-30 is located just west of the four-pack tanks (WM-187 through WM-190) (Figure 1-2).

5.10.1 Description of Release

Site CPP-30 was contaminated on June 2, 1975, during activities associated with valve maintenance inside Valve Boxes B-5 and B-9 (Figure 5-26). The contamination was the result of poor housekeeping during equipment maintenance activities, not the failure of any installed waste handling equipment. A Significant Operating Occurrence Report (Linhart 1975) describes the events associated with the contamination incident

5.10.1.1 Background of System Configuration and Leak. The tank farm has a complex system of interconnecting pipes and valves that allow waste to be transferred into and out of each waste tank. Concrete enclosures called valve boxes contain most of the valves on the waste transfer piping and provide access to the valves for repair, replacement, and other maintenance activities. On June 2, 1975, Maintenance personnel worked on the valves in Boxes B-5 and B-9, located west of Building CPP-635. The work included disassembling the valves within the valve box and moving the contaminated valve parts to another facility, where they were decontaminated and the parts salvaged for reuse. Premaintenance surveys indicated the radiation fields in Box B-9 were high (10 R/hr beta plus gamma), despite decontamination efforts, indicating considerable contamination remained in the piping, valves, and valve box itself.

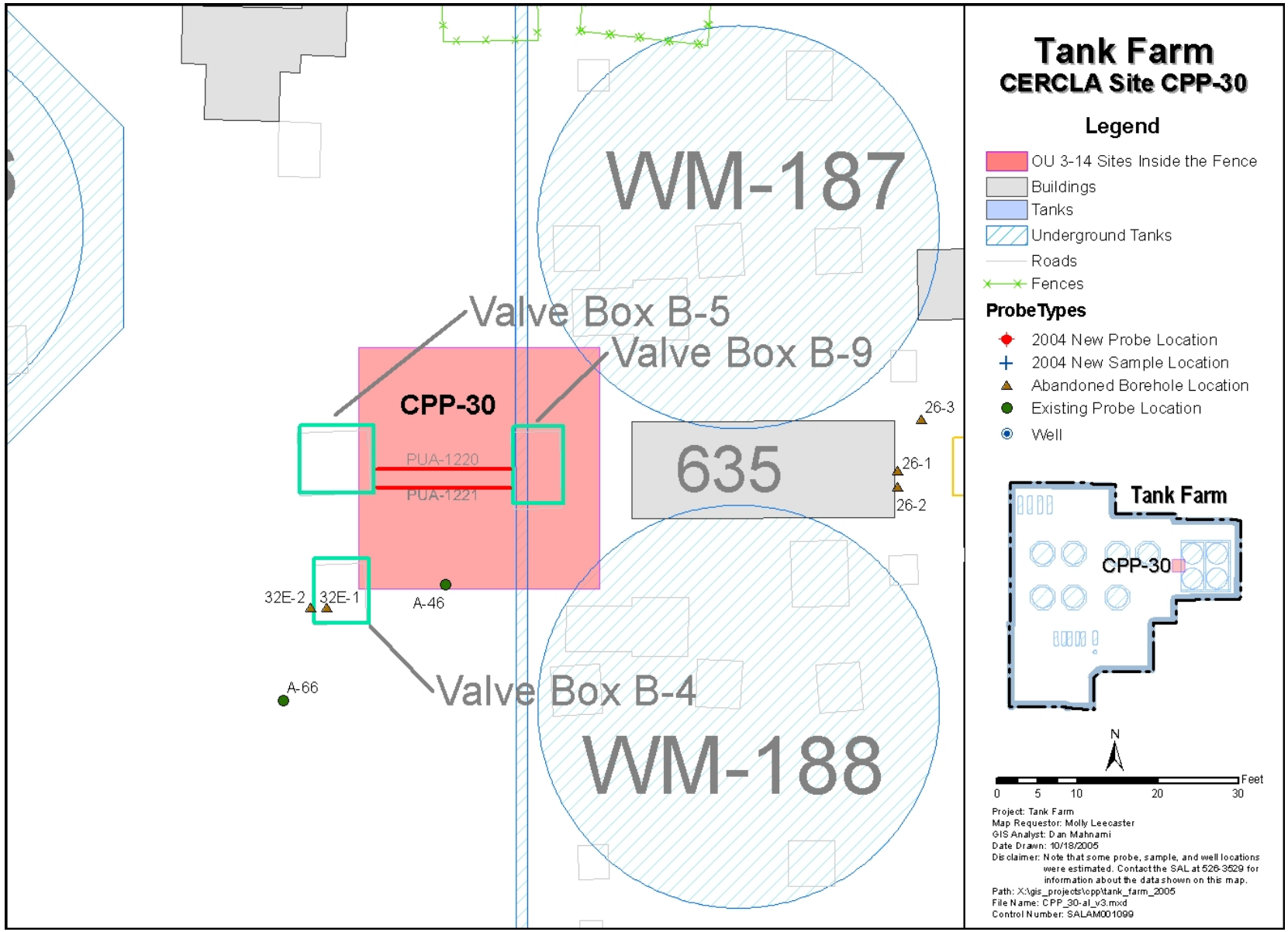

Figure 5-26. Detailed map of CPP-30.

When the contaminated valve parts were removed from the valve boxes, residue from the valves, tools, or workers (the workers and their clothing were contaminated) contaminated the soil around the two valve boxes. The area around the valve boxes had been covered with blotter paper to prevent soil contamination. However, the Occurrence Report indicates the blotter paper was torn in places where it had rested on the rocky tank farm surface and had been walked upon by personnel. In addition, the blotter paper coverage may have had gaps that allowed soil contamination to occur. The Occurrence Report recommended future tank farm work cover the lip of the concrete valve box with blotter paper, implying such coverage may not have existed with this particular job. Thus, although attempts were made to prevent soil contamination, the efforts were not completely successful.

5.10.1.2 Waste Source Term. Valve Boxes B-5 and B-9 were located on the transfer lines used to send waste to WM-187, -188, -189, and -190 and from those tanks to the WCF. Just prior to the contamination incident, the WCF had been processing waste from WM-188 and WM-189. The waste was first-cycle raffinate produced from reprocessing zirconium-clad fuel (Zr waste). The Zr waste was transferred to the WCF via Valve Boxes B-5 and B-9. Therefore, the contaminated residue in Valve Boxes B-5 and B-9 came from Zr waste such as that in WM-187, -188, and -189.

The waste in WM-187 and -188 was sampled in 1971 (Rhodes 1972). The waste in WM-188 and WM-189 was sampled in 1973 just prior to the beginning of WCF Campaign 6. The sample analyses generally included Cs-137, Sr-90, and H-3. The waste was not analyzed for I-129 or Tc-99. However, those components stay with the bulk of the fission products and can be calculated by fission yield with some minor adjustments. The waste source term and its basis follows:

Cs-137 = 0.70 Ci/L	(1970s Zr waste sample analyses)
Sr-90 = 0.70 Ci/L	(1970s Zr waste sample analyses)
H-3 = 1.5×10^{-4} Ci/L	(1970s Zr waste sample analyses)
Tc-99 = 1.1×10^{-4} Ci/L	(Fission yield for 7-yr-old Zr waste)
I-129 = 1.6×10^{-7} Ci/L	(85% of fission yield for 7-yr-old Zr waste to account for I-129 partitioning in dissolution and first-cycle extraction).

The nitrate content of the waste was about 2.4 M.

5.10.1.3 Waste Volume Leaked to Soil. There is no historical estimate of the volume of waste released because there was no release of any measurable volume of liquid waste; instead, it was a spread of loose, contaminated residue. The activity may have been liquid or solid residue from valves or tools or from footwear and clothing of the workers. The valve box and piping, both internal and external, were decontaminated and flushed with water prior to beginning the work on the valves. This likely reduced the activity and chemical content of the residue by one to two orders of magnitude from the activity of first-cycle raffinate given previously. A reasonably conservative estimate of the equivalent amount of diluted liquid that contaminated the soil would be 100 mL, or the equivalent of 1 to 10 mL of undiluted solution having the activity given in the source term section above. There was no reasonable mechanism to get larger amounts of liquid out of the valve box, since the contamination was residue on contaminated equipment and clothing, not from bulk-liquid-containing vessels or pipes. This amount is also consistent with the Occurrence Report that indicated contaminated soil readings ranged up to 1 R/hr. A few drops of first-cycle waste on the soil could result in such radiation readings. Several such spots could total to the equivalent of a few milliliters (1 to 10 mL of waste).

5.10.1.4 Source Term Summary. Site CPP-30 was contaminated by the spread of loose contamination by personnel from a controlled area (valve box) to the environment. It did not involve the failure of any installed primary or secondary containment system. Table 5-30 summarizes the activity and nitrate released to the soil at the time of the incident, conservatively assuming an equivalent 10 mL of first-cycle Zr waste was released. Table 5-30 provides the contaminants released without any consideration for the cleanup that occurred. Cleanup of the contamination commenced immediately after the incident occurred, which included removal of contaminated soil. There is likely very little contamination remaining from this incident. In comparison with other tank farm soil contamination sites, such as CPP-31 where approximately 17,000 Ci of Cs-137 leaked to the soil, CPP-30 is not significant in additive terms to a tank farm modeling source term. For example, the activity of Cs-137 released to Site CPP-31 is six orders of magnitude greater than the activity released to Site CPP-30. Thus, further detailed development of a source term for Site CPP-30 is not recommended.

5.10.2 Cleanup

The Occurrence Report indicates cleanup and removal of the contaminated soil commenced immediately after the incident. Thus, most of the contamination was removed at the time of the incident.

5.10.3 Previous Investigations

This site was recommended in a Track 2 investigation as a No Further Action site because the entire area has been excavated in the past and the contaminated soil was removed (DOE-ID 2004).

5.10.4 References

DOE-ID, 2004, *Operable Unit 3-14 Tank Farm Soil and Groundwater Remedial Investigation/ Feasibility Study Work Plan*, DOE/ID-10676, Rev. 1, U.S. Department of Energy Idaho Operations Office, June 2004.

Linhart, J. G., 1975, "Contamination, Valve Box B-9 Area," Significant Operating Occurrence Report 75-21, Allied Chemical Corporation, July 1975.

Rhodes, D. W., Allied Chemical Corporation, to Distribution, August 7, 1972, "Composition of First- and Second-Cycle Wastes," Rhod-4-72.

5.11 CPP-31

Site CPP-31 is associated with a large release during transfer of SBW from Tank WM-181 to WM-180 in 1972. An estimated 18,600 gal were released. It is the site with the largest release of curies in the tank farm and accounts for a vast majority of the radioactivity (greater than 87% of the Sr-90 and Cs-137 activity in OU 3-14). It is located in between the westernmost six tanks (WM-180 to WM-185, see Figure 1-2).

Table 5-30. Estimate of radionuclides and nitrate released at Site CPP-30.

Cs-137	Sr-90	H-3	Tc-99	I-129	NO_3
7 mCi	7 mCi	1.5 μCi	1.1 μCi	1.6 nCi	0.0015 kg

5.11.1 Description of Release

The release at CPP-31 is described in detail in this section. Site CPP-31 covers a relatively large area in the northwest portion of the tank farm in an area centered on Valve Box A-6. It was discovered in September 1975 when a project drilling groundwater monitoring wells found contaminated soil beneath the surface of the tank farm. Two system design features contributed to the CPP-31 soil contamination. A single isolation valve failed to provide an adequate barrier between the stainless-steel and carbon-steel portions of a waste transfer system. Also, the carbon-steel portion of the waste transfer system was not equipped with any secondary containment. An investigation report (Allied Chemical 1975), written after the discovery of the soil contamination, describes the leak, its causes, repair, costs, etc.

5.11.1.1 Background of System Configuration and Leak. In 1957, a tank farm expansion project installed two 300,000-gal storage tanks (WM-185 and WM-186). This project also installed a waste transfer piping system that could remove waste from the tanks and transfer it to other tanks or to the (future) WCF. The waste transfer piping included Line WRN-1037 that connected the tank farm cooling water system located in CPP-628 to the SBW transfer line PUA-1014. Line WRN-1037 was to have been used if the tank farm cooling water became contaminated due to the failure of a cooling coil in one of the tanks. The line provided a disposal path for the contaminated cooling water. Because the tank cooling water was not acidic and failure of a cooling coil and contamination of the cooling water was an unlikely event, most of the Line WRN-1037 was constructed of carbon steel and did not have any secondary encasement. Line WRN-1037 changed to a stainless-steel, pipe-in-pipe, encased line a few feet from its connection to the stainless-steel, SBW transfer line PUA-1014. A single valve (WRV-147) isolated the carbon-steel cooling water disposal line from the stainless-steel SBW waste line at the material transition point. Figure 5-27 shows the piping configuration near the location of the release.

In November 1972, the SBW in WM-181 was transferred to WM-180. WM-181 was emptied in order to serve as a temporary service waste diversion tank until a permanent diversion tank (WM-191) was constructed. The transfer of waste from WM-181 to WM-180 used Line PUA-1014, which was connected to the tank farm cooling water disposal line. The investigation report indicates the isolation valve (WRV-147) on the cooling water disposal line either leaked or was not fully closed during the waste transfer. This allowed SBW to enter the carbon-steel portion of Line WRN-1037, which failed rapidly in the acidic waste. The waste leaked from the failed line directly into the soil because there was no secondary containment around the failed carbon-steel portion of the line.

Following the discovery of the source of the leak, Line WRN-1037 was cut and capped, and Line PUA-1014 restored to normal service.

5.11.1.2 Waste Source Term. The primary source of the waste in WM-181 that leaked at CPP-31 was PEW evaporator concentrate produced from 1960 through 1967. The waste in WM-181 was sampled in 1971 and was virtually unchanged between the time it was sampled and when it was transferred to WM-180 in 1972. The 1971 analysis of the WM-181 waste (Rhodes 1972) was used as the basis for a radiological source term for the waste that leaked and contaminated the soil at CPP-31. Rhodes (1972) includes most of the major chemicals and radionuclides in the waste. The Cs-137 in the waste that leaked was 240 mCi/L (900 mCi/gal). The Sr-90 was a similar value, 210 mCi/L (810 mCi/gal). The H-3 activity was 0.034 mCi/L (0.13 mCi/gal).

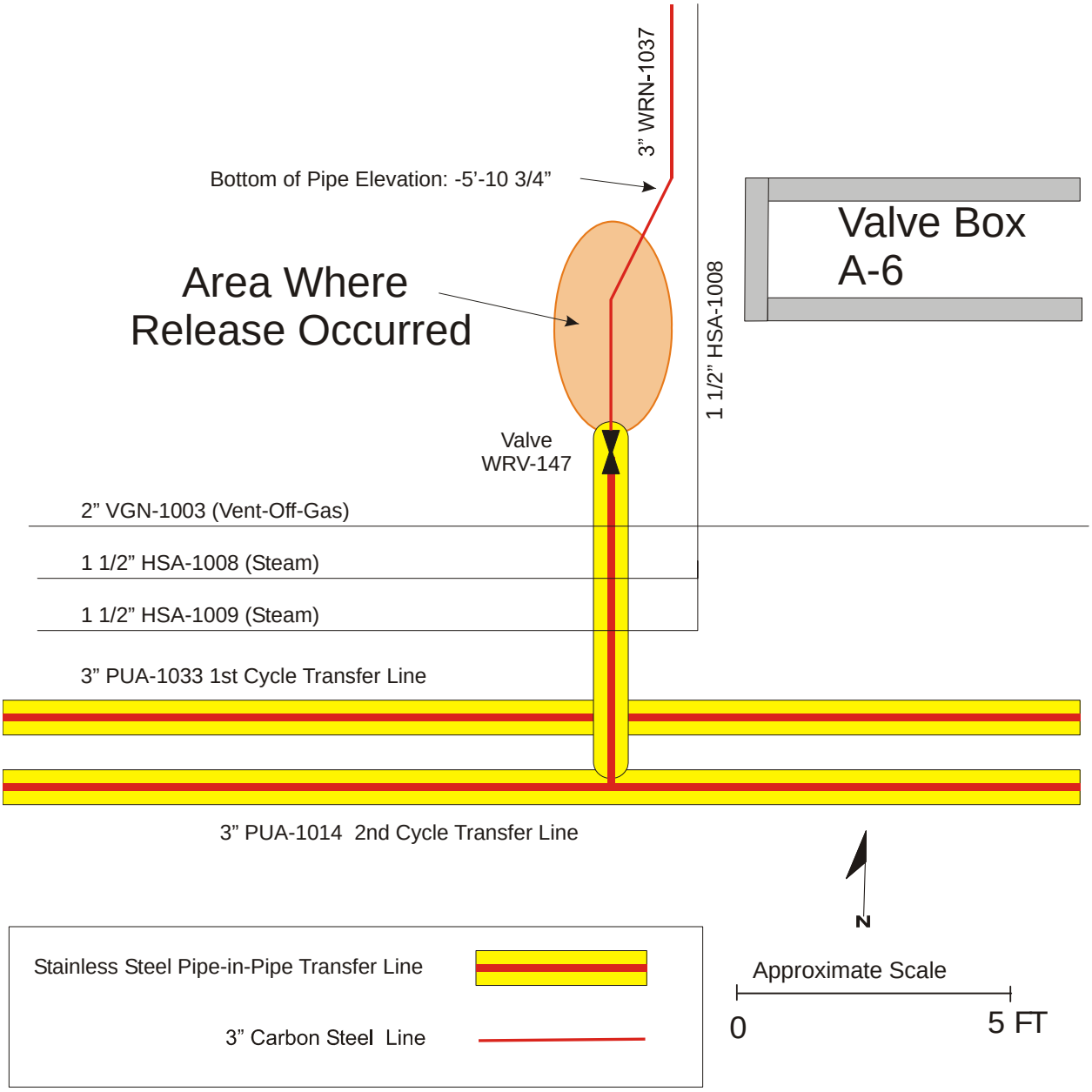

Figure 5-27. Plan view of the piping configuration at the CPP-31 release site.

Neither I-129 nor Tc-99 was included in the 1971 waste analyses. However, historical analytical data of other SBW indicate there was no measurable partitioning or separation of Tc-99 from Cs-137 in most tank farm wastes. Therefore, Wenzel (2004a) estimated the activity of Tc-99 in the WM-181 waste based upon fission yield and its ratio to the measured activity of Cs-137 in the waste.

Estimating the activities of I-129 and H-3 in the WM-181 waste by fission yield will overestimate the activities of both radionuclides. Therefore, a more realistic estimate was developed to provide a source term in order to calibrate the model. Tritium and I-129 volatilize and separate from other fission products in the PEW evaporator, the source of most of the WM-181 waste. The volatility of I-129 in the PEW evaporator depends on its speciation. Some species, such as I_2, are volatile in the evaporator, while

others, such as HgICl, are not (Schindler 1999). A model (McManus 1982) of the I-129 pathway through INTEC assumes 90% of the I-129 fed to the evaporator goes with the condensed vapors (to service waste) and 10% goes with the evaporator concentrate (to the tank farm). This produces a tank farm waste depleted in H-3 and I-129. Historical service waste and tank farm sample data confirm the H-3 activity in the SBW was generally lower than fission-yield activity, and its activity in service waste was higher than fission-yield activity (compared to Cs-137). Similarly, historical sample data show the activity of I-129 in the service waste was higher than the fission-yield activity (compared to Cs-137). Historical analyses of SBW from the tank farm generally had less than the laboratory detection activity of I-129.

Service waste sample data from the late 1970s and early 1980s (when I-129 analyses were performed) show a rough (order of magnitude) correlation between the activity of I-129 and H-3. The relative activities of H-3 and I-129 in the service waste were about the same as that in the fuel, indicating the two radionuclides went together through the INTEC waste treatment systems. A reasonable estimate of the I-129 activity in the WM-181 waste can be made by assuming it behaved the same as H-3 in the PEW evaporator, the source of most of the waste. The estimate requires a "H-3 reduction factor," which is the ratio of the activity of H-3 in the WM-181 waste compared to its fission-yield activity. Rhodes (1972) provides sample activity data for H-3 and Cs-137 in the WM-181 waste. Using this data, the H-3 reduction factor for WM-181 was about 0.05. Wenzel (2004a) applied this factor to the fission-yield value to estimate I-129 activity in the WM-181 waste.

The 1971 WM-181 sample data differed from most historical SBW. The Cs-137 activity in the 1971 WM-181 waste was several times higher than typical SBW, and the H-3 activity was lower, resulting in a lower H-3 reduction factor (0.05) than typical SBW (about 0.2). There are reasons for the differences in the WM-181 composition. A portion of the WM-181 waste (several tens of thousands of gal) came from concentrating WCF scrub solution in the PEW evaporator during the first two WCF operating campaigns. Valve failures at the WCF prevented the normal recycling of scrub solution into the calciner feed system. The Cs-137 activity of the WCF scrub solution was about half that of first-cycle raffinate, which was several orders of magnitude higher than typical evaporator feed solution. This generated PEW evaporator concentrate (and WM-181 waste) with a higher-than-normal Cs-137 activity.

The low H-3 activity in the WM-181 waste may have been the result of adding water to the PEW evaporator in the early 1960s to strip nitric acid from the concentrate and obtain a higher waste concentration factor in the evaporator. This action would also strip H-3 and I-129 from the evaporator and lower their activities in the concentrate.

Historical H-3 analyses were more erratic than other radionuclides, such as Cs-137. Unfortunately, there are no replicate sample analyses or other means to validate the measured H-3 activity in the 1971 WM-181 waste. Given the average H-3 reduction factor in SBW and the historically large deviation in H-3 analyses, the H-3 in the WM-181 sample may be low. The use of a H-3 (and I-129) reduction factor of 0.05 is a reasonable starting point for a groundwater modeling source term estimate because the purpose of the estimate it to develop a realistic source term in order to calibrate the model. However, the hydrogen reduction factor could be increased (which would increase the H-3 and I-129 activity) to as much as 0.2 (a factor of 4) and be consistent with historical SBW, if needed to reconcile groundwater model irregularities.

The nitrate content of the WM-181 waste is documented in Rhodes (1972) as 4.38M. That is a reasonable value for SBW.

5.11.1.3 Waste Volume Leaked to Soil. The exact volume of waste that leaked to the soil in CPP-31 is unknown. The original investigation report estimated the leakage at 14,000 gal. The investigation report indicated 271,000 gal of waste were transferred from WM-181 into WM-180 in November 1972, but WM-180 received only 265,000 gal. The precision and accuracy of the 1972 liquid level monitors were not as good as current instrumentation. The recorded tank volumes were accurate to about 500 gal. Therefore, the reported 6,000-gal discrepancy in the sent/received volumes was accurate to within 1,000 gal.

The waste transfer was made with a steam-powered pump called a steam jet. Steam jets convert high-pressure steam energy into kinetic energy (motion) of the liquid being transferred. In the jet, the steam mixes with and condenses in the liquid being transferred, which increases the total volume of the liquid transferred. Thus, more liquid is received than is transferred when using steam jets. This volume difference is termed "jet dilution." The leak investigation report indicated the amount of liquid received in WM-180 should have been 8,000 gal more (due to jet dilution) than the amount sent from WM-181. Since the transfer resulted in a 6,000-gal shortfall in the waste received, and it should have had an 8,000-gal surplus, the report concluded 14,000 gal leaked to the soil.

A 14,000-gal leak correlates with a jet dilution of only 3 volume percent (8,000 of the 271,000 gal transferred). Many studies have used 5 volume percent for the average value of tank farm jet dilution. Historical data show most tank farm transfers have jet dilution values ranging between 2 and 8%. The amount of jet dilution assumed with the transfer is important due to the large volume of waste transferred with the CPP-31 leak. Each 1% jet dilution equates to about 2,700 gal of leakage. The amount of jet dilution varies with each waste transfer and cannot be precisely predicted. The amount of jet dilution depends on parameters that include the density of the waste to be transferred, the vertical lift required of the transfer, and the jet design. Transfers that require more motive force require more steam than transfers requiring less motive force. For example, transfers from full tanks require less steam and have less jet dilution than transfers from nearly empty tanks. This is because less energy (steam) is required to lift solution from a full tank to a given height (the main transfer piping) than from an empty tank to the same height. Similarly, transfers of heavy (high-density) solution require more energy (steam) and have more jet dilution than transfers of lighter solution. Tanks WM-180 and WM-181 are buried deeper than any other tank farm tanks, and their waste transfer piping comes all the way up to grade level. This results in the highest lift of any waste transfer system in the tank farm. The specific gravity of the 1972 WM-181 solution (1.26) was higher than typical first-cycle raffinate (1.15-1.20), which means the WM-181 waste was heavier and required more energy (steam) than the average waste (first-cycle raffinate) to lift out of the tank. As a result, the waste transfer from WM-181 to WM-180 should have required more motive force and had more than 3% steam jet dilution, which is in the lower end of the historical operating range. The use of only 3% jet dilution may underestimate the amount of waste that leaked to the ground. The use of 5% for the jet dilution would yield 13,550 gal of steam condensate and a total leakage of 19,550 gal to the soil, a value 40% higher than the original estimate. The composition of the leaking waste was that given for WM-181 in Rhodes (1972) multiplied by a factor of 0.95 to account for jet dilution. This would be the equivalent of 18,600 gal of "undiluted" WM-181 waste leaking to the soil. For the purpose of adjusting a groundwater model, the variability of this leak estimate is about 4,000 gal (1,000 gal in the measured waste volumes and 3,000 gal in about 1% jet dilution variance).

5.11.1.4 Source Term Summary. Site CPP-31 was contaminated by SBW that leaked during a WM-181 to WM-180 transfer in November 1972. The composition of the WM-181 waste is well documented (Rhodes 1972) for most of the major waste constituents. However, some waste constituents, such as I-129 and Tc-99, must be estimated. The volume of waste that leaked has historically been given as 14,000 gal. That volume is not a conservative (high) estimate and appears to be low based on historical operating data. A reasonable estimate of the volume of waste that leaked is about 18,600 gal. Due to the

precision of the tank level instrumentation of the 1970s and the use of steam jets to transfer tank farm waste, there is considerable variability in the estimate of the volume of waste that leaked at CPP-31. The waste volume leaked could vary nearly 4,000 gal (up or down) from the estimate of 18,600 gal.

Table 5-31 summarizes the activity of major radionuclides and mass of nitrate released at Site CPP-31, assuming 18,600 gal of waste with 0.90 Ci/gal Cs-137 and 4.38-molar nitrate were released (radionuclides from Wenzel [2004b] and Rhodes [1972]).

5.11.2 Cleanup

No records documenting cleanup at this site have been located. Results from OU 3-14 and previous investigations discussed below indicate that a significant fraction of the contamination originally released to soil remains in the alluvial soils.

5.11.3 Previous Investigations

In September 1973, 10 monitoring wells (A-40 through A-49) (Figure 5-28) were drilled and installed by the United States Geological Survey (USGS) at various locations in and around the tank farm as part of an effort to learn how water was entering the vaults of certain waste storage tanks. Unfortunately, field records for this series of wells were not found and details of the work are not well documented. The holes were drilled to bedrock using an auger rig and cased with 2-in.-diameter aluminum pipe. The bottom 6 ft of pipe were screened to permit shallow perched water to enter the observation well. It is believed that no contamination was encountered in the drill cuttings during drilling of these wells, based on the fact that unusual occurrence reports were not generated for installation of these wells. In addition, the wells were reportedly logged with a downhole gamma detector resulting in no indication of contamination, but no gamma-logging results could be located. As of 1993, Wells A-40, -41, -42, -43, and -47 have been either destroyed or removed.

In September 1975, 10 additional monitoring wells (A-50 through A-59) (Figure 5-28) were drilled and installed to extend the monitoring network to the older part of the tank farm. On September 18, 1975, while drilling monitoring well A-53, located approximately 15 ft southwest of Tank WM-183 and 10 ft south of the edge of the tank vault (Figure 5-28), contaminated soil was brought to the surface. Beta/gamma radiation levels in the auger drill cuttings reportedly ranged from 100 mR/hr at 15 ft bgs to 500 mR/hr at 22 ft bgs. A radiation profile was taken by lowering a radiation detector into the hollow-stem augers. Readings greater than 10 R/hr were measured at depths of 14, 18, 19, and 23 ft below grade. Well A-55, located southwest of WM-185, also encountered contaminated soil but at lower concentrations than A-53.

Table 5-31. Estimate of major radionuclides and nitrate released at Site CPP-31 in 18,600 gal of waste.

Cs-137	Sr-90	H-3	Tc-99	I-129	NO_3
16,700 Ci	15,100 Ci	2.42 Ci	3.17 Ci	2.51E-04 Ci	19,100 kg

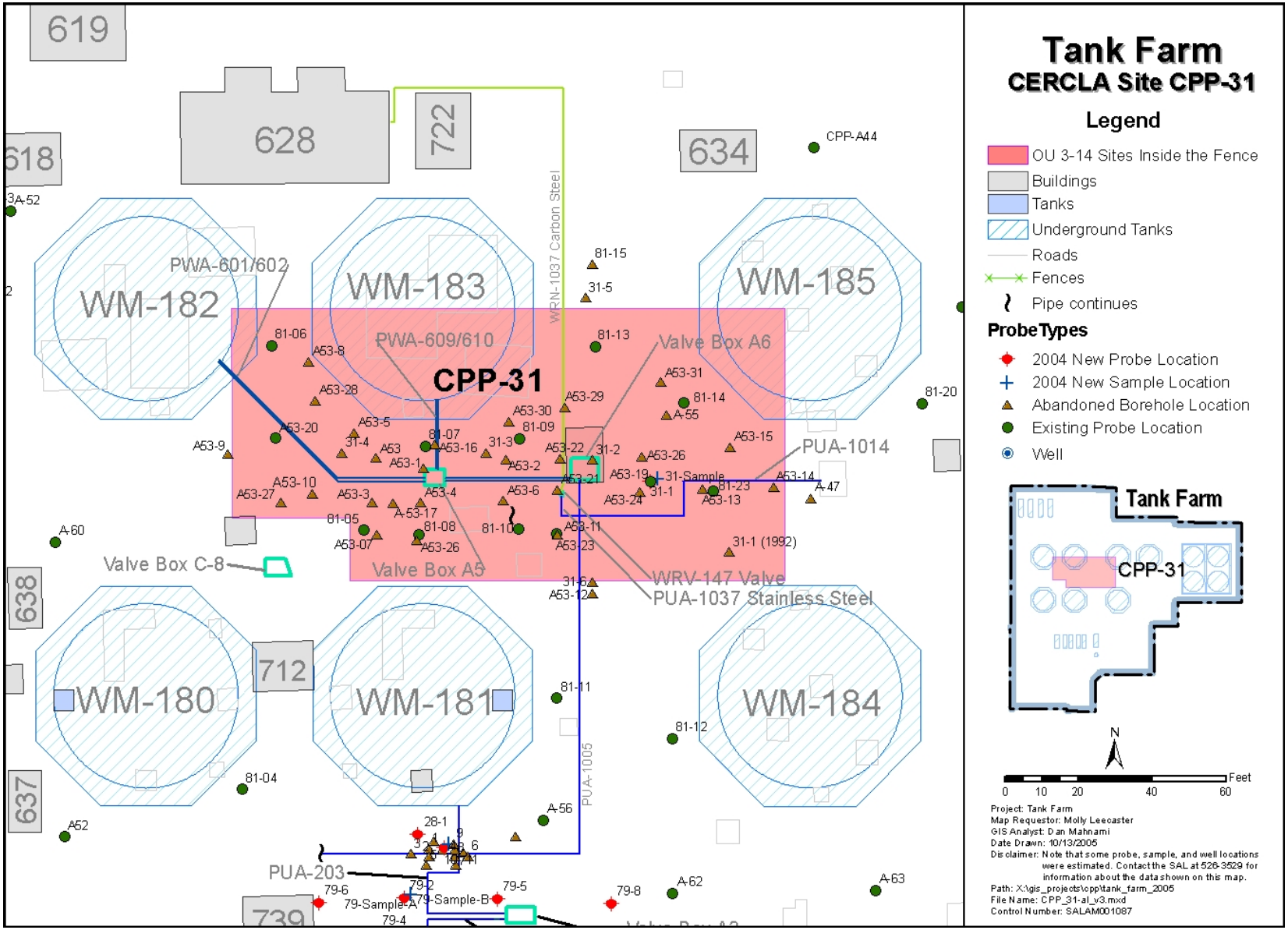

Figure 5-28. CPP-31 release site boundary and locations of monitoring wells and soil probes in and around the release site.

Fifteen additional exploratory holes (A-53-1 through A-53-15) were drilled to a depth of 25 ft by the USGS to define the limits of the contaminated area. Soil samples and a radiation measurement plot were collected from each hole. These holes were not cased and were backfilled as the bit was removed. Contaminated soil was encountered in nine of the 15 holes (A-53-1, -2, -3, -4, -5, -6, -10, -13, and -15). Sixteen additional soil probe pipes (A-53-16 through -31) were driven into the ground between early November and December 7, 1975, to help pinpoint the source of contamination and further characterize the lateral and vertical extent. Location A-53-18, just north of Valve Box A-6, was unique in that radiation between 1.3–3.4 R/hr was measured at 4, 9, and 10 ft bgs. This suggested that the leak might have originated from a point above the elevation of the main waste lines located in the concrete encasements.

Following the installation of boreholes and observation wells, direct readings were obtained from the subsurface by lowering a string of thermoluminescent dosimeter chips down the cased hole or drill rod, exposing the chips for 1 hr. The results of these measurements taken in 1975 are presented in Table 5-32. The vertical contaminant distribution in some of the boreholes was believed to be somewhat distorted due to the auger drill used. Activity near the top of the holes was considered to be primarily activity augered up from the main pocket of activity at a depth of 12 to 25 ft. Likewise, higher levels of activity at the bottom of the hole were considered to be the result of drill bit contamination and contaminated soil falling into the hole from the highly contaminated horizons above. The data presented were used to develop maps depicting the lateral extent of contaminated soil (Figures 5-29 and 5-30). Five fence diagrams (Figures 5-31 through 5-35) show the vertical contaminant distribution along various transects through the contaminated zone. The gamma log data used to create the fence diagrams were combined with 2004 sample data and interpolated into a three-dimensional image (see Figure 5-36). The contaminant distribution appears to be associated with zones of preferential movement in the horizontal direction, mainly along waste transfer lines 3”PWA-601/602 connecting Valve Boxes A-5 and A-6 to WM-182 and waste transfer lines 3”PWA-609/610 buried approximately 11 to 12 ft bgs.

In the early 1980s, several additional monitoring wells, designated the “81 series,” were installed in the tank farm area near CPP-31 (Figure 5-28). As a part of the 1992 OU 3-07 Track 2 investigation (WINCO 1993), radiation profile surveys were performed on 10 existing wells, including eight of the 81 series wells. Results of the 1992 surveys are presented in Table 5-33. A comparison of those results to previous subsurface radiation profile measurements is inconclusive as to whether migration has occurred since the time of release or if the radiation levels in the soil were increasing or decreasing over time.

Based on the number of monitoring wells installed and their associated radiation profiles, the lateral and vertical extent of the contaminated soil appears to be adequately bounded, with the exception of a small area east of Valve Box A-6 along the piping runs of 3”PUA-1005 and 3”PUA-1030. Monitoring well A53-25 encountered contaminated soil but did not penetrate the vertical extent of contamination at that location.

Table 5-32. Direct radiation measurements in 1975 from boreholes or observation wells installed at Site CPP-31 after the release.

Depth (ft)	Borehole or Observation Well (all measurements in R/hr)															
	A53	A53-1	A53-2	A53-3	A53-4	A53-5	A53-6	A53-7	A53-8	A53-9	A53-10	A53-11	A53-12	A53-13	A53-14	A53-15
1	1.0	1.0	0.3	0.5	0.2	0.015	0.4	0.02	0.01	0.01	1.0	0.01	0.01	0.3	0.007	0.55
2	—[a]	—	—	0.6	0.2	0.01	0.35	0.01	0.01	—	1.5	—	—	—	—	0.61
3	—	—	—	0.65	0.35	0.04	0.4	0.01	—	—	1.5	—	—	—	—	0.45
4	—	—	—	0.6	0.4	0.07	0.4	0.01	—	—	1.5	—	—	—	—	0.5
5	1.5	2.0	0.25	0.6	0.5	0.2	0.45	0.05	0.01	0.01	1.5	0.085	0.02	0.5	0.003	0.5
6	—	—	—	—	1.0	0.5	0.5	0.02	—	—	1.5	—	—	—	—	0.6
7	—	—	—	0.65	1.3	1.6	0.55	0.02	—	—	1.5	—	—	—	—	0.35
8	—	2.0	—	0.6	1.0	2.5	0.55	0.01	—	—	1.5	—	—	—	—	0.3
9	—	3.0	—	0.6	1.8	4.0	0.55	0.01	—	—	1.5	—	—	—	—	0.2
10	2.0	2.5	0.45	0.5	1.1	3.5	0.7	0.01	0.005	0.01	1.5	0.01	0.015	0.55	0.005	0.2
11	—	3.0	0.5	0.6	2.0	4.0	0.8	0.01	—	—	—	—	—	—	—	0.2
12	—	3.0	1.5	0.6	2.5	5.0	0.9	0.01	—	—	2.0	—	—	—	—	0.2
13	2.0	>10.0	>10.0	2.0	4.0	5.0	>10.0	0.01	—	—	2.0	—	—	—	—	0.15
14	>10.0	8.0	1.5	7.0	3.5	7.0	>10.0	0.005	—	—	>10.0	—	—	0.9	0.01	0.2
15	3.0	1.5	0.1	0.6	2.0	4.5	0.35	0.006	0.005	0.003	>10.0	0.005	0.01	3.0	0.005	0.3
16	3.0	2.0	—	0.45	3.0	5.5	0.1	0.004	—	—	4.0	—	—	0.5	0.006	5.0
17	10.0	>10.0	—	0.85	8.5	9.0	0.1	0.003	—	—	2.0	—	—	0.5	—	4.0
18	>10.0	>10.0	—	9.0	>10.0	>10.0	0.1	0.002	—	—	10.0	—	—	—	—	0.2
19	>10.0	5.0	—	1.4	3.0	>10.0	0.05	0.003	—	—	0.6	—	—	—	—	0.1
20	2.5	0.2	0.01	1.1	2.5	8.5	0.05	0.008	0.003	0.006	0.35	0.006	0.006	0.035	0.003	0.05
21	2.5	—	—	—	0.7	10.0	0.05	0.004	—	—	0.20	—	—	—	—	0.01
22	5.0	—	—	—	—	6.0	0.02	0.004	—	—	0.10	—	—	—	—	0.01
23	>10.0	—	—	0.15	—	1.0	0.025	0.005	—	—	0.10	—	—	—	—	0.01
24	6.0	—	—	—	—	0.15	0.03	0.01	—	—	0.1	—	—	0.015	—	0.01
25	0.3	0.2	0.08	0.25	2.0	1.0	0.04	—	—	—	—	—	—	—	—	—

Table 5-32. (continued).

Depth (ft)	Borehole or Observation Well (all measurements in R/hr) (continued)															
	A53-16	A53-17	A53-18	A53-19	A53-20	A53-21	A53-22	A53-23	A53-24	A53-25	A53-26	A53-27	A53-28	A53-29	A53-30	A53-31
1	<0.001	<0.001	<0.001	<0.001	<0.001	—	—	Bkg[b]	0.02	Bkg	0.02	0.015	Bkg	Bkg	—	Bkg
2	<0.001	<0.001	<0.001	<0.001	<0.001	1.0	0.05	Bkg	4.06	0.04	0.02	Bkg	Bkg	Bkg	—	Bkg
3	<0.001	<0.001	0.02	<0.001	<0.001	9.8	0.06	Bkg	Bkg	0.03	0.03	0.02	Bkg	0.035	Bkg	Bkg
4	<0.001	<0.001	1.3	<0.001	<0.001	23.7	1.79	Bkg	3.9	0.18	Bkg	Bkg	Bkg	2.03	Bkg	Bkg
5	<0.001	<0.001	0.1	<0.001	<0.001	41.8	6.29	Bkg	Bkg	0.03	Bkg	Bkg	Bkg	Bkg	Bkg	Bkg
6	<0.001	<0.001	0.1	<0.001	<0.001	50.2	3.13	Bkg	0.02	0.04	0.02	0.04	Bkg	0.03	0.01	Bkg
7	<0.001	<0.001	0.1	<0.001	<0.001	49.2	0.38	Bkg	0.02	0.02	0.03	Bkg	Bkg	Bkg	0.06	Bkg
8	<0.001	<0.001	0.2	<0.001	<0.001	46.1	0.13	Bkg	0.01	0.04	0.03	Bkg	Bkg	0.2	0.01	Bkg
9	<0.001	<0.001	3.4	0.002	<0.001	49.2	0.18	Bkg	0.06	0.04		Bkg	Bkg	7.5	Bkg	Bkg
10	<0.001	0.002	2.8	0.005	<0.001	40.0	—	Bkg	0.02	0.19		Bkg	Bkg	1.6	Bkg	Bkg
11	<0.001	0.006	0.34	0.1	<0.001	24.8	—	Bkg	0.03	0.47		Bkg	—	0.2	0.08	Bkg
12	0.03	0.04	0.27	0.15	0.004	27.8	—	Bkg	0.26	2.0		Bkg	Bkg	4.0	0.60	Bkg
13	1.1	1.78	3.1	1.9	0.22	27.3	—	Bkg	4.9	2.6		Bkg	Bkg	1.5	0.10	Bkg
14	11.6	8.2	8.8	16.0	7.3	26.9	—	Bkg	14.9	33.9	Broken Pipe Coupling In Casing	6.6	Bkg	—	0.04	Bkg
15	15.1	15.2	1.76	28.0	9.8	22.6	—	Bkg	16.2	40.1		—	Bkg	—	—	Bkg
16	2.4	23.5	5.4	23.0	6.8	10.3	—	Bkg	20.2	43.2		—	0.07	—	—	Bkg
17	1.9	6.8	0.25	13.0	16.4	12.3	—	Bkg	3.8	34.5		—	0.8	—	—	Bkg
18	8.6	19.9	0.04	3.4	1.57	1.16	—	Bkg	1.6	36.6		—	5.8	—	—	Bkg
19	12.6	2.1	0.03	2.3	0.16	0.61	—	Bkg	1.6	—		—	—	—	—	Bkg
20	0.6	3.3	0.04	4.0	0.7	—	—	Bkg	—	—		—	—	—	—	Bkg

a. — = no reading taken at that depth.
b. Bkg = background.

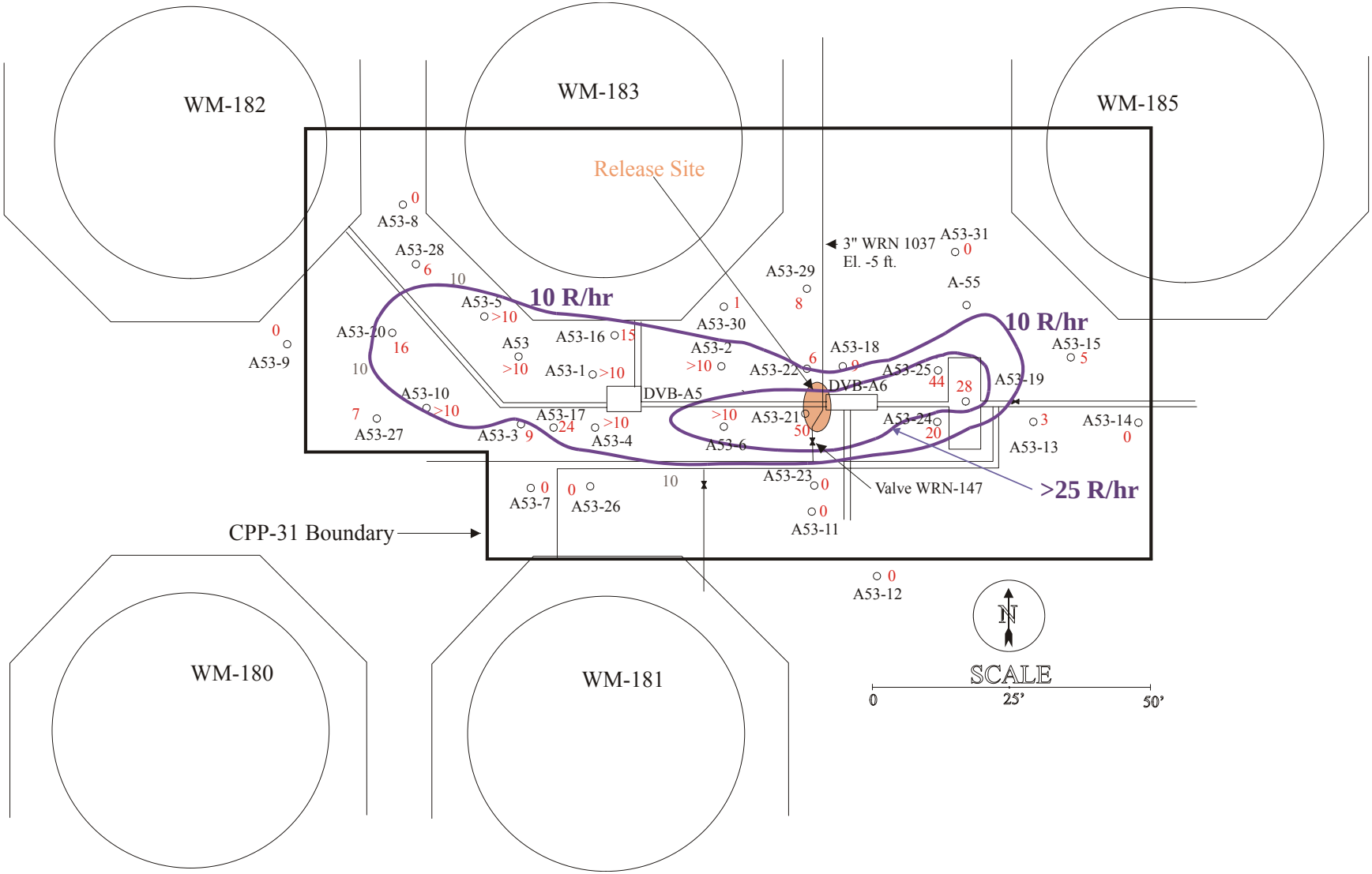

Figure 5-29. Extent of lateral contamination at the CPP-31 release site (measurements from 1975 in R/hr).

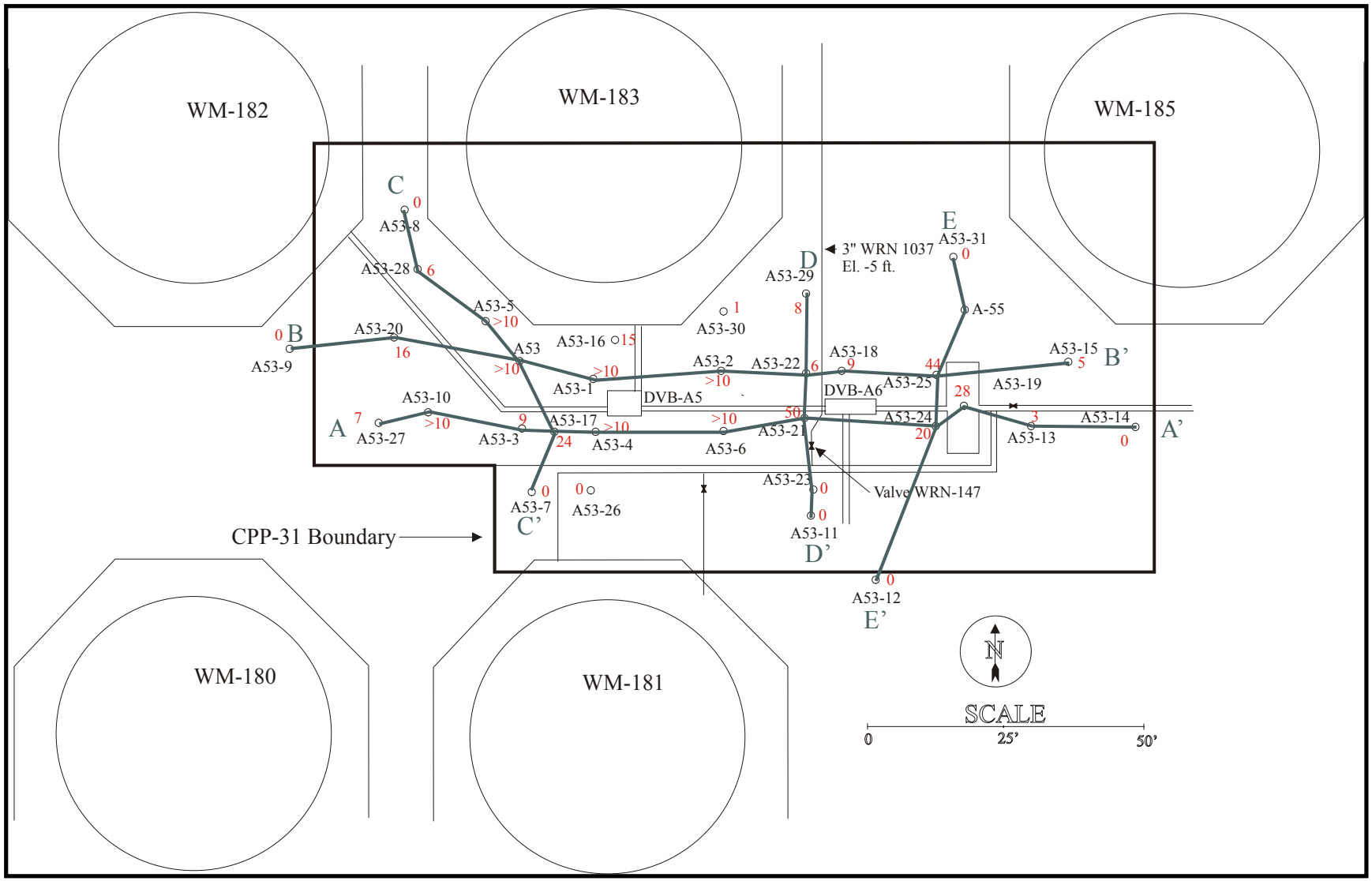

Figure 5-30. Map showing lateral extent of soil contamination (measurements from 1975 in R/hr) at CPP-31 and locations of fence diagrams.

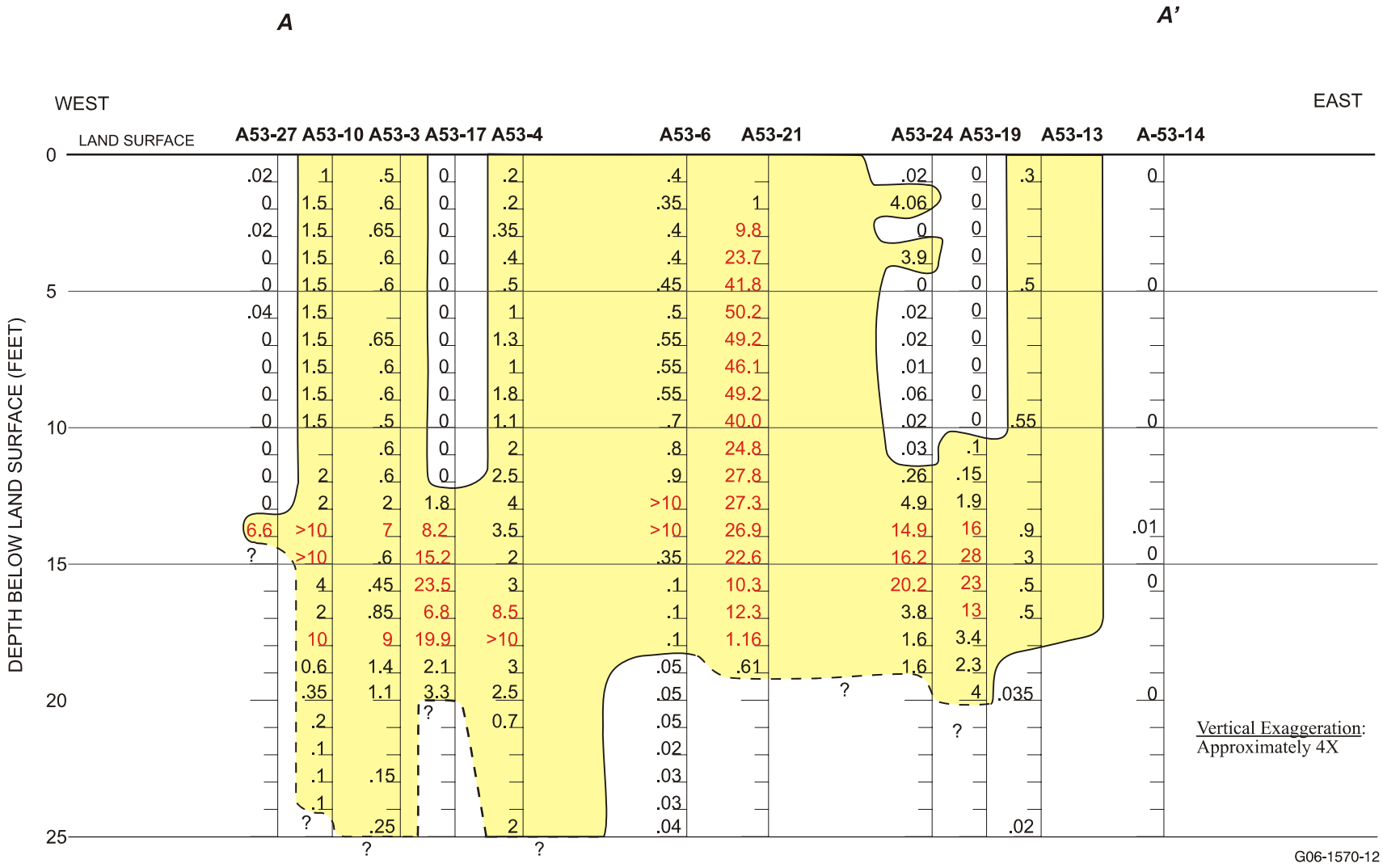

Figure 5-31. East-to-west, A-to-A', fence diagram through the CPP-31 zone of contamination (1975 radiation readings are in R/hr; readings >5 R/hr are shown in red). Zone of contamination is defined as ≥ 0.1 R/hr. Blanks indicate no reading was taken at that depth, but the estimated zone of contamination includes these if a deeper reading was greater than 0.1 R/hr. A 0 value indicates the reading was at background level or less than 0.01.

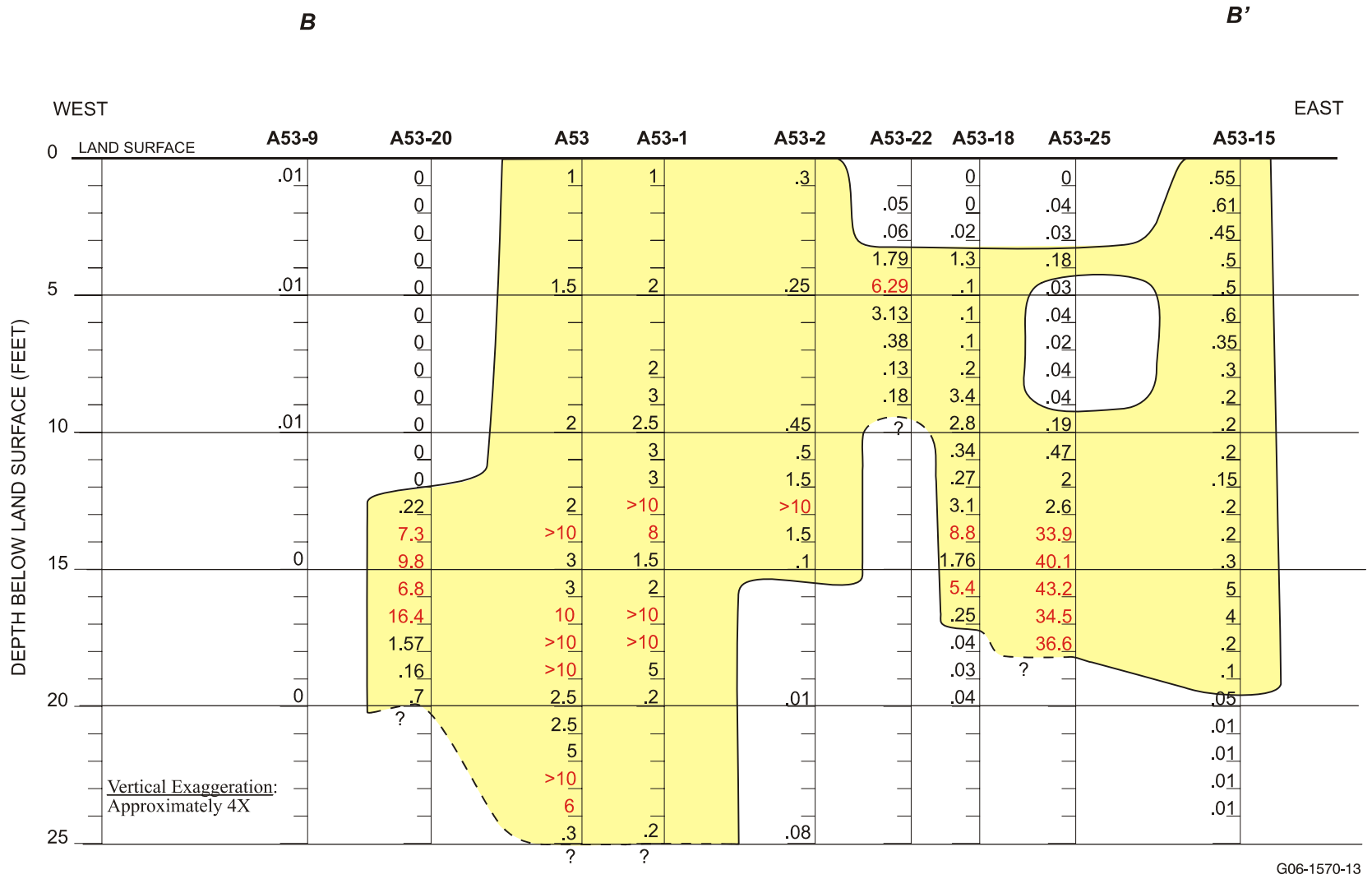

Figure 5-32. West-to-east, B-to-B', fence diagram through the CPP-31 zone of contamination (1975 radiation readings are in R/hr; readings >5 R/hr are shown in red). Zone of contamination is defined as ≥ 0.1 R/hr. Blanks indicate no reading was taken at that depth, but the estimated zone of contamination includes these if a deeper reading was greater than 0.1 R/hr. A 0 value indicates the reading was at background level or less than 0.01.

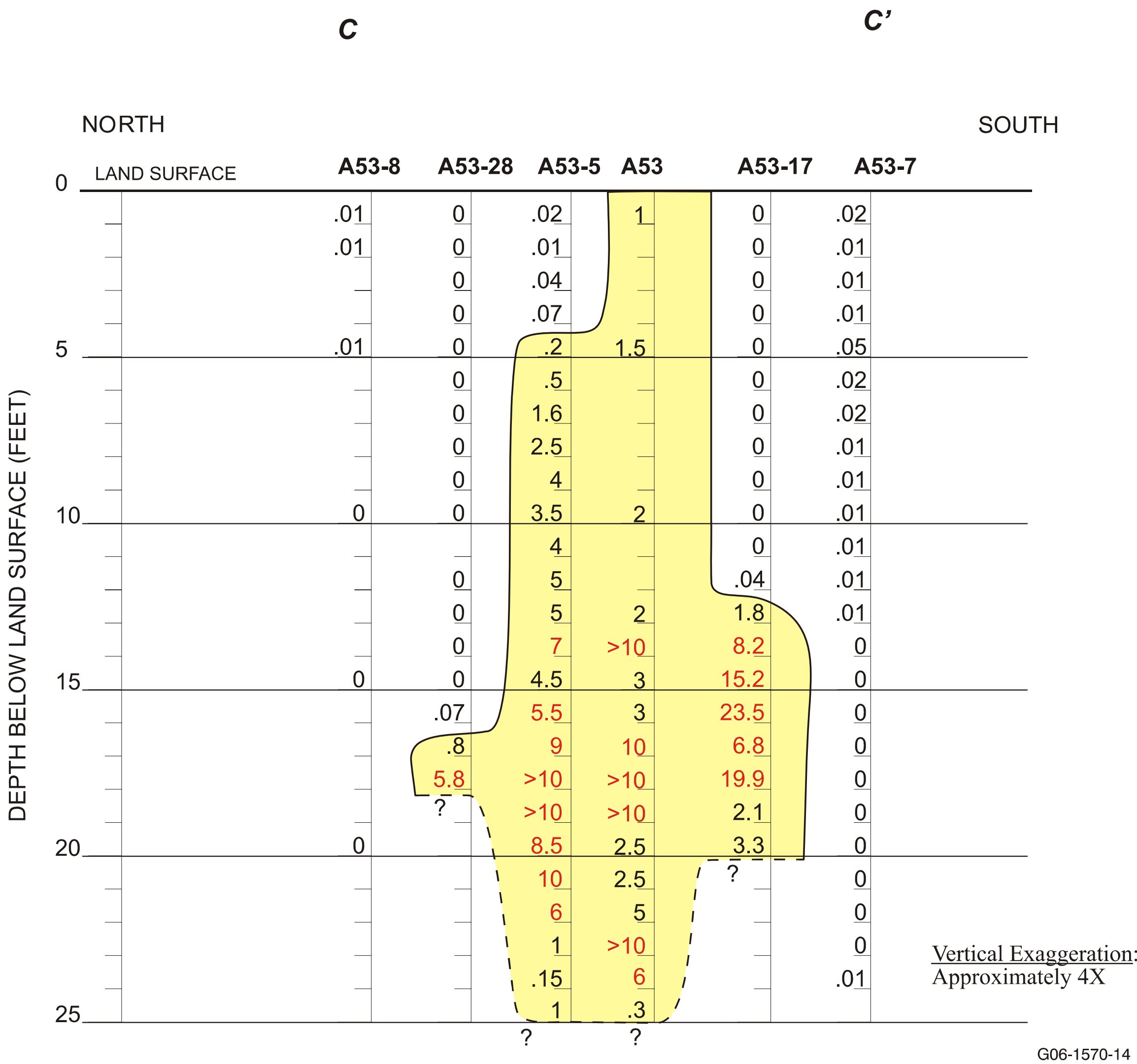

Figure 5-33. North-to-south, C-to-C', fence diagram through the body of contaminated soil at CPP-31 (1975 radiation readings are in R/hr; readings >5 R/hr are shown in red). Zone of contamination is defined as ≥ 0.1 R/hr. Blanks indicate no reading was taken at that depth, but the estimated zone of contamination includes these if a deeper reading was greater than 0.1 R/hr. A 0 value indicates the reading was at background level or less than 0.01.

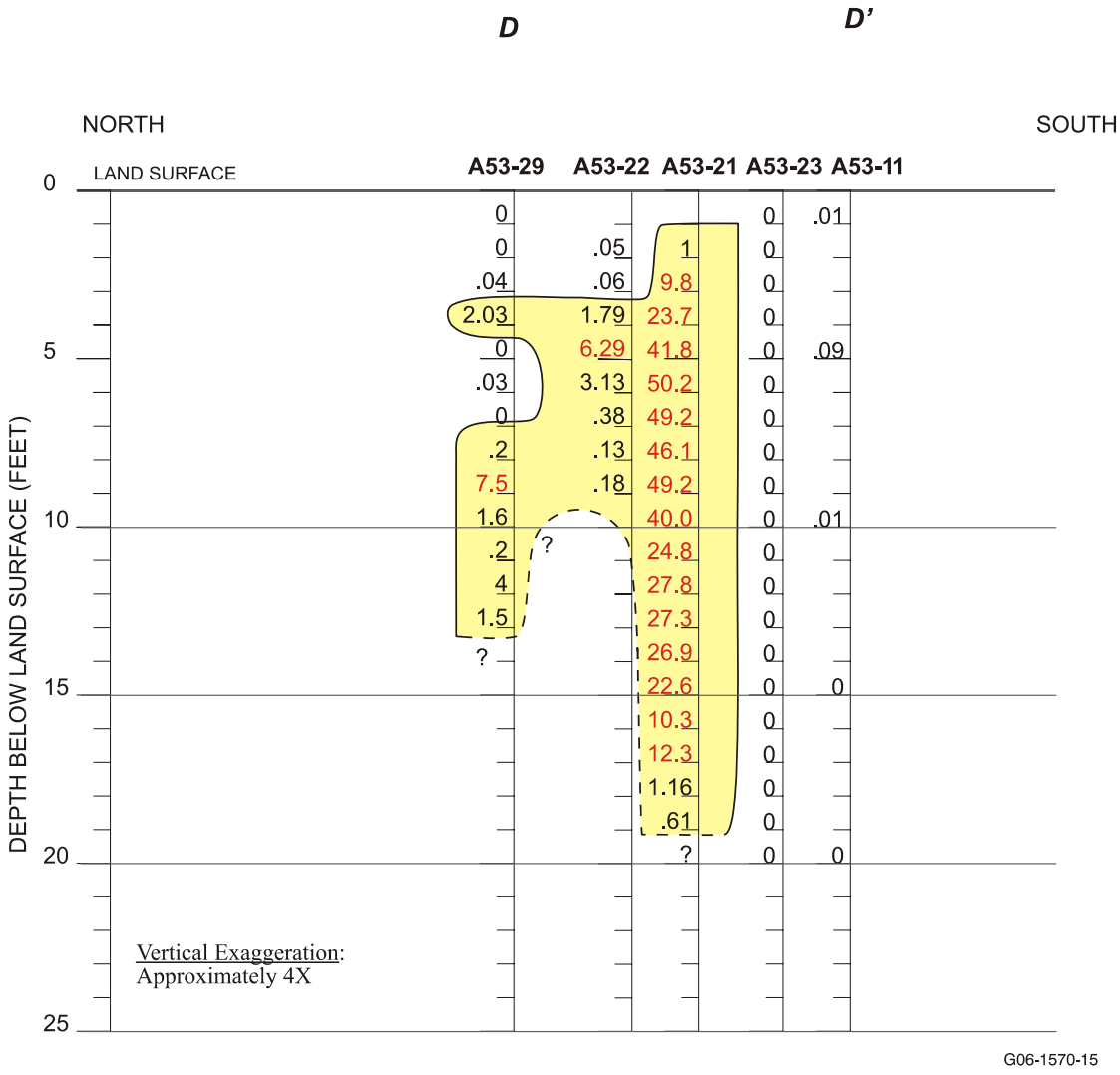

Figure 5-34. North-to-south, D-to-D', fence diagram through the body of contaminated soil at CPP-31 (1975 radiation readings are in R/hr; readings >5 R/hr are shown in red). Zone of contamination is defined as ≥ 0.1 R/hr. Blanks indicate no reading was taken at that depth, but the estimated zone of contamination includes these if a deeper reading was greater than 0.1 R/hr. A 0 value indicates the reading was at background level or less than 0.01.

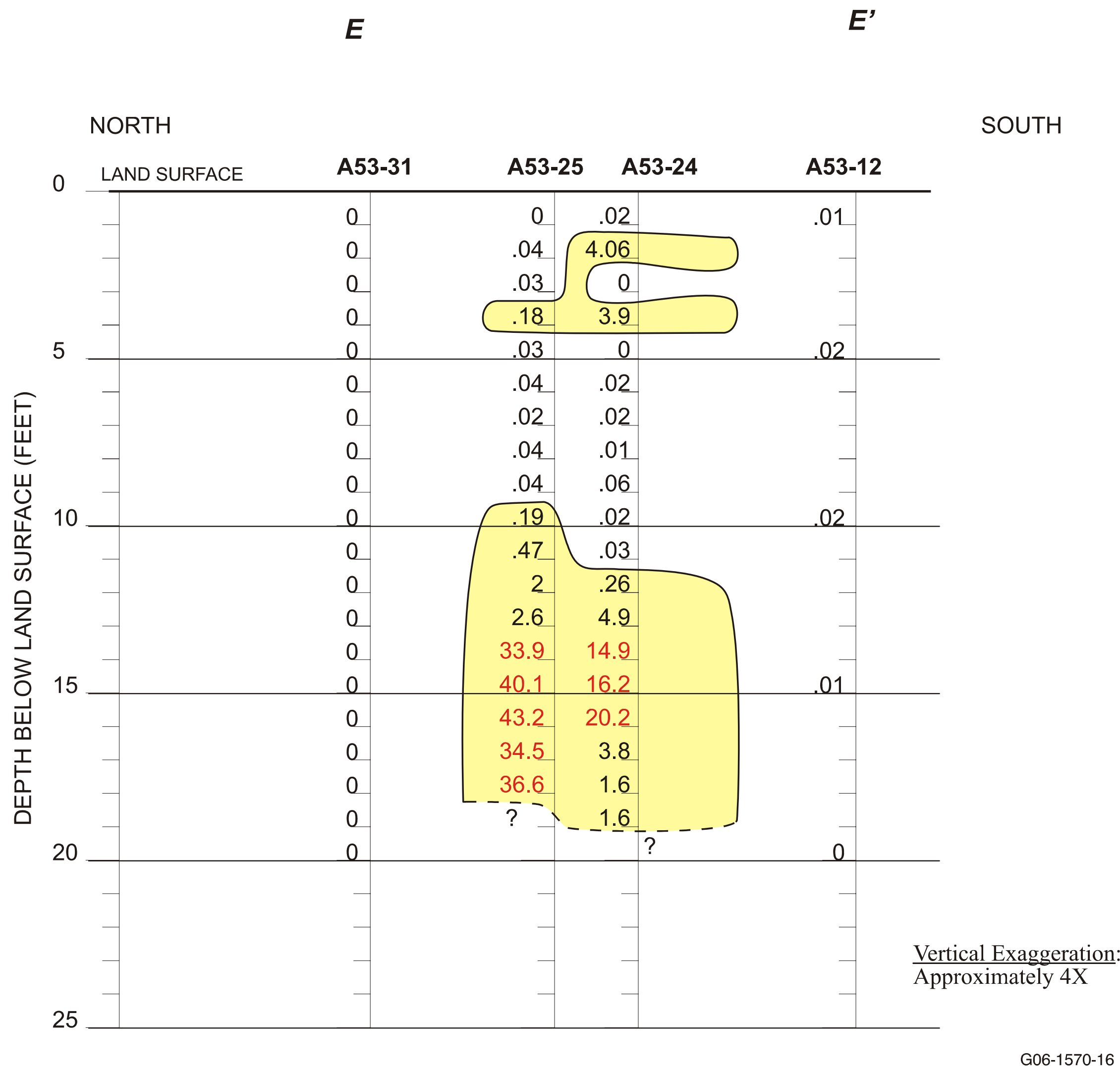

Figure 5-35. North-to-south, E-to-E', fence diagram through the body of contaminated soil at CPP-31 (1975 radiation readings are in R/hr; readings >5 R/hr are shown in red). Zone of contamination is defined as ≥ 0.1 R/hr. Blanks indicate no reading was taken at that depth, but the estimated zone of contamination includes these if a deeper reading was greater than 0.1 R/hr. A 0 value indicates the reading was at background level or less than 0.01.

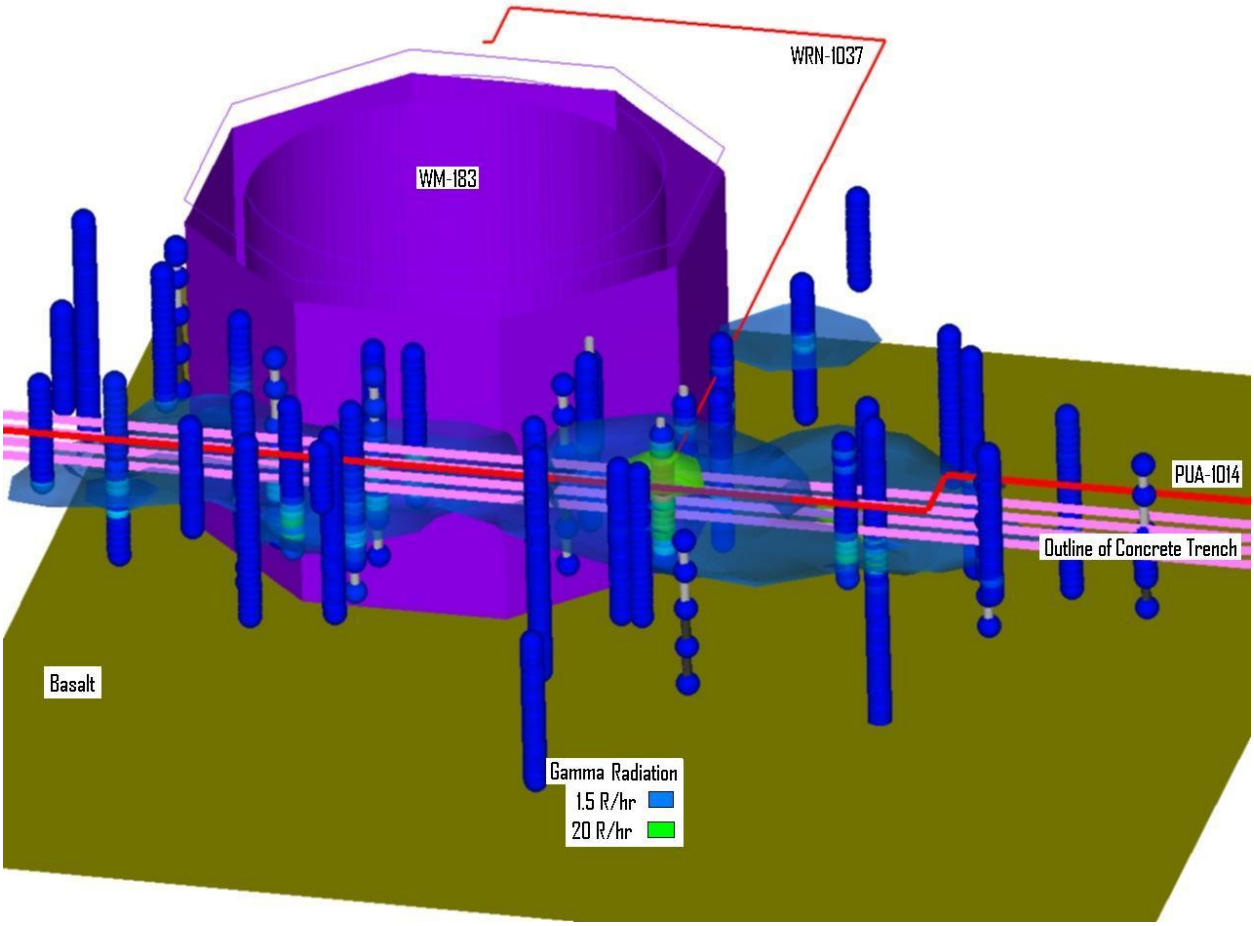

Figure 5-36. Volumetric prediction of gamma radiation extent within the CPP-31 leak zone. The top of the basalt is shown in dark green, the tank vault for WM-183 in purple, PUA-1037 and PUA-1014 lines in red, and a covered concrete trench outlined in pink. The observed gamma-logging locations are shown on the tubes. The plume represents 20 R/hr in green and 1.5 R/hr in blue.

Table 5-33. Summary of the subsurface radiation profile performed on selected probes at Site CPP-31 on August 18, 1992.

Depth (ft)	Probe Number (exposure rate in R/hr)									
	A53-11	A53-19	81-3	81-6	81-7	81-8	81-9	81-10	81-13	81-14
2	0.1	0.1	0	0.1	0.1	0.1	0.1	0	0.1	0
4	0.1	0.1	0	0.1	0.1	0.1	0.1	0	0.1	0.1
6	0.1	0.1	0	0.1	0.1	0.1	0.1	0	0	0.1
8	0.1	0.1	0	0.1	0.1	0.1	0.1	0	0.2	0
10	0.2	0.1	0	0.1	0.1	0	0.1	0	7.4	0.1
12	0.1	0.1	0	0.1	0.1	0.1	1.2	0	0.2	0.1
14	0.1	0.2	0	0.1	0.1	0.1	0.2	0	0.1	0.1
16	0.1	13.1	0	0.1	0.3	0.1	1.1	0	0.1	0.1

Table 5-33. (continued).

Depth (ft)	Probe Number (exposure rate in R/hr)									
	A53-11	A53-19	81-3	81-6	81-7	81-8	81-9	81-10	81-13	81-14
18	0.1	22.3	0.5	0.1	0.6	0	0.1	0	0.1	9.3
20	0.1	9.0	0.1	0.1	0.1	0.1	0.1	0	0.1	0.1
22	0.1			0.1	8.4	0.1	0.1	0		0.1
24	0.1			0.1	8.8	0.1	0	0		0.1
26				0.1		0.1	0.1	0		0
28				0.1			0.1	0		0
30				0.2						0
				Note: >1.5 @ 29 ft						

5.11.4 OU 3-14 Investigation

5.11.4.1 Scope. The OU 3-14 field investigation was focused on resolving remaining data gaps for CPP-31 described below. Details of the OU 3-14 field investigation at CPP-31 are provided in Appendix H. Those include

- Sample collection procedures
- Sample documentation, custody, handling, and transportation
- Analytical methods
- Data reporting
- Quality control.

Details of the location and installation of gamma-logging probeholes and sampling coreholes are summarized below and provided in detail in Appendix F.

5.11.4.2 DQOs. DQOs for the OU 3-14 field investigation for CPP-31 are summarized in Table D-10 of DOE-ID (2004). The composition of contamination present was inadequately known to resolve Decision Statements 2 and 3. Specifically, a complete analysis of remaining soil contamination for all COPCs, including organic compounds and metals and Tc-99 and I-129, was needed to improve confidence in the source term used for BRA groundwater modeling and for the FS analysis of alternatives, including treatment, retrieval, and disposal. Process knowledge of the Tc-99 and I-129 present in the release was subsequently improved as previously described.

Additionally, samples were needed to determine the mobility of remaining contamination and for the BRA groundwater modeling. Existing sampling results were inadequate to define the composition of the contamination or the mobility. The vertical extent of contamination east of Valve Box A-6 in the vicinity of A53-25 was also considered inadequately bounded.

The field investigation strategy formulated to obtain the decision inputs needed to resolve the decision statements included

- Collecting one continuous core to basalt in the vicinity of A53-25 and sampling and analysis for the COPCs listed in Table 5-6
- Archiving excess sample material for possible subsequent K_d or treatability studies.

Probehole installation is described in Appendix F. Samples were collected in 4-ft intervals in core barrels using GeoProbe direct-push tooling and analyzed for the constituent list shown in Table 5-6. Results are summarized in Table 5-34 below and are provided in total in Appendix G. Casing was installed and the hole was gamma-logged using the AMP-50. Gamma readings for each depth interval are listed in Appendix F, Table D-1.

5.11.4.3 Probing and Gamma-Logging Investigation. Probehole installation is described in Appendix F. Probehole CPP-31-1 (CPP-1874) was pushed at the location shown on Figure 5-28 vertically 39.6 ft to basalt. The probehole was gamma-logged using both the AMP-50 and AMP-100. Gamma-logging results are shown in Appendix F, Table D-1.

Probehole CPP-31-Sample (CPP-1875) was pushed adjacent to Probehole CPP-31-1 to basalt at a depth of 39.5 ft bgs. Samples were collected in 4-ft intervals in core barrels using GeoProbe direct-push tooling and analyzed for the constituent list shown in Table 5-5. Results are summarized in Table 5-34 and are provided in total in Appendix G.

5.11.4.4 Results. OU 3-14 field investigation analytical results are summarized in Table 5-34 and in Table D-1 from Appendix F. Table 5-34 includes only a subset of analytical results and does not include laboratory or validation flags, sampling errors, or MDL, "ND" represents compounds that were U- or UJ-flagged; and "0" represents compounds detected at low levels but the decimal places are not shown. Complete detailed sampling results are provided in Appendix G. Elevated gamma readings (> 1 mR/h) were observed during logging of Probehole CPP-31-1 beginning at 11.3 ft bgs and increasing to a maximum of 9.4 R/hr at a depth of 16.3 ft bgs. Readings declined and remained between 1 and 5 mR/h from 25.3 ft bgs to completion of the probehole at basalt.

Sampling results for CPP-31-1(CPP-1874) are summarized in Table 5-34 and are presented in full in Appendix G. Results indicate elevated Cs-137 throughout the 0 to 40-ft interval, with a maximum of 8,990,000 pCi/g at 18-20 ft bgs. The gamma activity in the 16- to 18-ft interval exceeded 500 mR/h, which exceeded field handling limits and was greater than the contracted analytical laboratory handling limits. This core was archived pending project review.

Table 5-34. Summary of analytical results for samples obtained at CPP-31 during the 2004 OU 3-14 field investigation.

Depth (ft)	Cs-137 (pCi/g)	Sr-90 (pCi/g)	Pu-238 (pCi/g)	Pu-239/240 (pCi/g)	I-129 (pCi/g)	Tc-99 (pCi/g)	Nitrate-N (mg/kg)	Hg (mg/kg)	Cr (mg/kg)	Am-241 (pCi/g)	Eu-154 (pCi/g)	U-233/234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Np-237 (pCi/g)	pH	H-3 (pCi/g)
0-4	214	ND[a]	ND	ND	ND	ND	0[b]	0	29.1	1	ND	1	ND	1	ND	9.2	ND
6-8	438	175	1	ND	ND	ND	0	0	37.8	ND	ND	1	ND	1	ND	9.1	ND
10-12	428	815	3	1	ND	ND	0	0	26.5	1	ND	2	1	1	ND	9.1	ND
14-16	241,000	547,000	958	202	ND	13	0	5.49	28.6	128	247	6	2	1	0	9.1	ND
16-18	3,720,000	1,320,000 (total)	—[c]	—	—	—	—	0.629	—	—	1,600	—	—	—	—	—	—
18-20	8,990,000	1,850,000	41,800	8,530	ND	69	0	38.50	60.2	8,970	9,620	432	133	47	20	8.5	ND
22-24	57,500	20,700,000	100	22	ND	23	0	27.10	22.9	17	ND	4	0	1	0	9.0	ND
26-28	63	810,000	ND	ND	ND	25	0	0.56	31.4	ND	ND	2	ND	1	ND	9.2	ND
30-32	126	663,000	1	ND	ND	17	0	0.46	26.7	ND	ND	2	1	1	ND	9.2	ND
32-36	73	941,000	ND	ND	ND	16	0	0.15	34.0	0	ND	2	ND	1	ND	9.2	ND
36-40	33	528,000	ND	ND	ND	7	0	ND	33.2	ND	ND	2	0	1	ND	9.4	ND
36-40 dup	32	603,000	1	ND	ND	65	0	0	34.2	ND	ND	2	0	1	ND	9.5	ND

a. ND = not detected (U) or false positive (UJ).
b. 0 = compound detected at low level, but decimal places not shown.
c. — = not analyzed for.

In March 2005, the archived core was placed inside the CPP-684 shielded hot cell for remote sampling. A limited analysis, including gamma spectroscopy, total strontium, and total mercury, was performed on the sample. Cs-137 concentrations decline below the 18- to 20-ft interval to 32 pCi/g at the 36- to 40-ft interval at the basalt-alluvium contact.

Maximum Sr-90 results are 20,700,000 pCi/g in the 22- to 24-ft bgs interval. Sr-90 concentrations remain high from 24 ft bgs to basalt, ranging from 941,000 to 528,000. The concentration of Sr-90 at the soil-basalt interface at 36-40 ft bgs was 603,000 pCi/g.

Maximum concentrations of Pu-238 and Pu-239/240 of 41,800 pCi/g and 8,530 pCi/g, respectively, occurred in the 18- to 20-ft interval. Tc-99 was detected in the 18- to 20-ft interval at 69 pCi/g and at elevated concentrations ranging from 7 to 65 pCi/g between 22 ft bgs and basalt. I-129 was not detected.

Concentrations of INTEC liquid waste system listed RCRA constituents cited in INEEL (1999) are provided in Appendix G. Concentrations of all constituents analyzed for were below detection limits.

5.11.5 Contamination Remaining in Alluvium

This section summarizes results of all investigations and process knowledge of the release in the context of

- Nature of contamination including ranges of contaminant concentrations observed
- Areal and vertical extent of contamination remaining in the alluvium
- Volume of contaminated alluvium present.

5.11.5.1 Nature of Contamination. Field observations from 2004 and previous investigations are consistent with the conceptual model of release of PEW evaporator concentrate from Line WRN-1037 at a depth of approximately 6 ft. This waste had very high Cs-137 and Sr-90 concentrations and was relatively depleted in I-129 and H-3. Field observations are consistent with the conceptual model and process knowledge of the release. Most of the Cs-137 contamination released at CPP-31 remains in the alluvium, while more of the Sr-90, which is more mobile, has migrated into perched water, as discussed previously.

5.11.5.2 Vertical Extent. The subsurface radiation profiles presented and discussed in Section 5.11.3 indicate that high levels of gamma activity are present at depths typically greater than 7 ft bgs. Elevated gamma activity shallower than a depth of about 12 ft bgs is suspected to have been dragged up from greater depths by the hollow-stem auger flights used to install the 81-series probeholes. The principal zone of contamination is believed to extend from about 12 ft bgs to about 25 ft bgs. The distribution of contamination appears to follow waste transfer lines PWA-601/602 connecting Valve Boxes A-5 and A-6 to WM-182 and waste transfer lines PWA-609/610 buried about 11-12 ft bgs.

Probehole CPP-31-1 (CPP-1874) and CPP-31-Sample (CPP-1875) were pushed near the location of Probehole A-53-25, which did not show reduced gamma activity at the completion depth of 21 ft bgs, indicating that contamination had migrated deeper. Gamma logging of CPP-31-1 (CPP-1874) indicated that elevated gamma activity of 1-5 mR/h continued to the basalt interface, and analytical results from CPP-31-Sample (CPP-1875) indicate that Sr-90 migrated to basalt at this location. These results indicate that some fraction of the Sr-90 released migrated to basalt at this location.

5.11.5.3 Areal Extent. As indicated in Figure 5-28, the areal extent of contamination at CPP-31 extends at least 125 ft east-west and about 30 ft north-south and appears to have migrated along the concrete enclosure housing waste transfer lines PWA-601/602 connecting Valve Boxes A-5 and A-6 to WM-182 and waste transfer lines PWA-609/610 buried about 11-12 ft bgs.

5.11.5.4 Remaining Curies. The areal extent of CPP-31 is described within CPP-96. Contamination remains at CPP-31 from ground surface to 40 ft bgs. Essentially none of the roughly 30,000 Ci of contamination originally released was removed from this site. The release inventory comprises about 85% of the total tank farm release inventory.

5.11.6 Uncertainties/Data Gaps

Table 5-35 summarizes resolution of data gaps for CPP-31. The concentration profile determined at CPP-31-Sample (CPP-1875) indicates that, while most of the Cs-137 and Pu are retained in the alluvium near the depth of the initial release, Sr-90 has migrated at high concentrations to the alluvium-basalt interface and likely beyond. At a minimum, the 16- to 18-ft sample should be analyzed, if possible, so that the relative amounts of Cs-137 and Sr-90 remaining in the soil column can be more accurately estimated. This estimate can be compared to the ratios present in the original release, and the fraction of Sr-90 released that is still retained in the alluvium can be estimated. Additional sampling of vertical soil profiles at CPP-31 would further refine the estimate of Sr-90 activity remaining in the alluvium. Uncertainty in future Sr-90 concentrations in the SRPA could be further reduced by determining the mobility of the Sr-90 remaining in the tank farm alluvium at CPP-31.

Table 5-35. Summary of data gaps for Site CPP-31.

Decision Statements	Extent Known Adequately To Resolve Decision Statement?	Distribution Known Adequately To Resolve Decision Statement?	Composition Known Adequately To Resolve Decision Statement?	Properties[a] Known Adequately To Resolve Decision Statement?
1. Determine whether or not soil exposure risks to future workers at CPP-31 exceed allowable levels, requiring control of the exposure pathway.	Yes. Incorporated into soils inside the tank farm boundary (Section 5.18).	Yes. Incorporated into soils inside the tank farm boundary (Section 5.18).	Yes. Contaminant composition consistent with conceptual model of release.	Properties information is not needed to resolve Decision Statement 1.
2. Determine whether or not contaminants are transported out of the tank farm soils to the SRPA at rates sufficient to result in COPC concentrations exceeding allowable levels at the exposure point, requiring control of the exposure pathway.	Yes. Vertical extent of Sr-90 remaining in alluvium is adequately known.	Yes. Distribution of Sr-90 remaining in alluvium vs. migrated to basalt is adequately known.[b]	Yes. Contaminant composition consistent with conceptual model of release.	Yes. Mobility of Sr-90 remaining in alluvium is adequately known.[b]

Table 5-35. (continued).

Decision Statements	Extent Known Adequately To Resolve Decision Statement?	Distribution Known Adequately To Resolve Decision Statement?	Composition Known Adequately To Resolve Decision Statement?	Properties[a] Known Adequately To Resolve Decision Statement?
3. Determine whether or not a remedial action that includes [GRA][c] best meets FS evaluation criteria to mitigate excess risks, relative to other alternatives.	Yes. Incorporated into CPP-96.	Yes. Incorporated into CPP-96.	Yes. Contaminant composition consistent with conceptual model of release.	Yes. Chemical form and mobility of Sr-90 remaining in alluvium are adequately known.[b]

a. Properties refer to physicochemical parameters for fate and transport modeling of groundwater contamination source term and parameters needed to evaluate in situ or ex situ treatment for release sites that present significant risks to groundwater. Knowledge of properties is not needed for sites that do not pose significant groundwater risks based on the estimated fractional radionuclide mass present.
b. Based on field data in combination with geochemical model (see Appendix J).
c. GRAs to be evaluated include No Action, Institutional Controls, Containment (including capping), Treatment (in situ and ex situ), Retrieval, and Disposal.

5.11.7 References

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5.12 CPP-32E

Site CPP-32E is a small site located west of the four-pack tanks (WM-187 to WM-190), near the southwest corner of Site CPP-30 (see Figure 1-2, Figure 5-37). It is contaminated soil associated with sampling liquid in Valve Box B-4 sump.

5.12.1 Description of Release

Site CPP-32E was likely contaminated in December 1976 with liquid that dripped from the equipment used to sample liquid in the Valve Box B-4 sump. Most of the activity released was likely removed a few weeks after the release occurred.

5.12.1.1 Background of System Configuration and Leak. Site CPP-32 is a small area (8 ft^2) near the southwest corner of Valve Box B-4, a few yards southwest of Building CPP-635. Ison (1976) documents the discovery of the contamination at CPP-32E and hypothesized the contamination came from a standpipe adjacent to Valve Box B-4, presumably because the standpipe was also contaminated. Based on that statement, DOE-ID (2004) and similar historical reports postulated a scenario in which waste leaking from valves within the valve box generated vapors that left the valve box via an inspection/sample port (termed a "standpipe" in Ison [1976] and a "vent tube" in DOE-ID [2004]), condensed, and dripped upon the ground. While that scenario is possible, this report provides another scenario that is more likely, given the system configuration, historical events, and activity of the soil contamination.

Most of the tank farm valves are enclosed in concrete vaults (valve boxes) that provided access for personnel to maintain the valves on the waste transfer lines. Each valve box typically has a stainless-steel liner that drained to a sump within the box. Originally, most of the valve box sumps drained to a nearby tank vault. In the mid 1970s, each box was equipped with an access pipe that penetrated the roof of the box directly above the sump and extended to an accessible point above grade. The access pipe was an inspection/sample port and was used to determine if any waste leaks occurred within the box. If liquid was seen in the box sump, a sample could be retrieved from the sump via the inspection/sample port and analyzed to determine if the liquid was from a leaking valve or ingress from rainfall or snowmelt.

DOE-ID (2004) postulated condensate from vapors exiting the inspection/sample port condensed and contaminated Site CPP-32E. However, the soil contamination levels (up to 2 R/hr) seem too high to have been caused by condensed vapor. For comparison, Site CPP-24 was likely contaminated by condensate from vaporized first-cycle raffinate (see previous CPP-24 description). The waste that evaporated, condensed, and contaminated the CPP-24 site was much higher in radionuclide activity (over 1,400 Ci/gal) due to much shorter fuel cooling times than the 1970s first-cycle waste (about 20 Ci/gal) that may have evaporated, condensed, and contaminated the ground near Valve Box B-4. The CPP-24 site was contaminated with an estimated 1 gal of liquid. The volume of condensate from the B-4

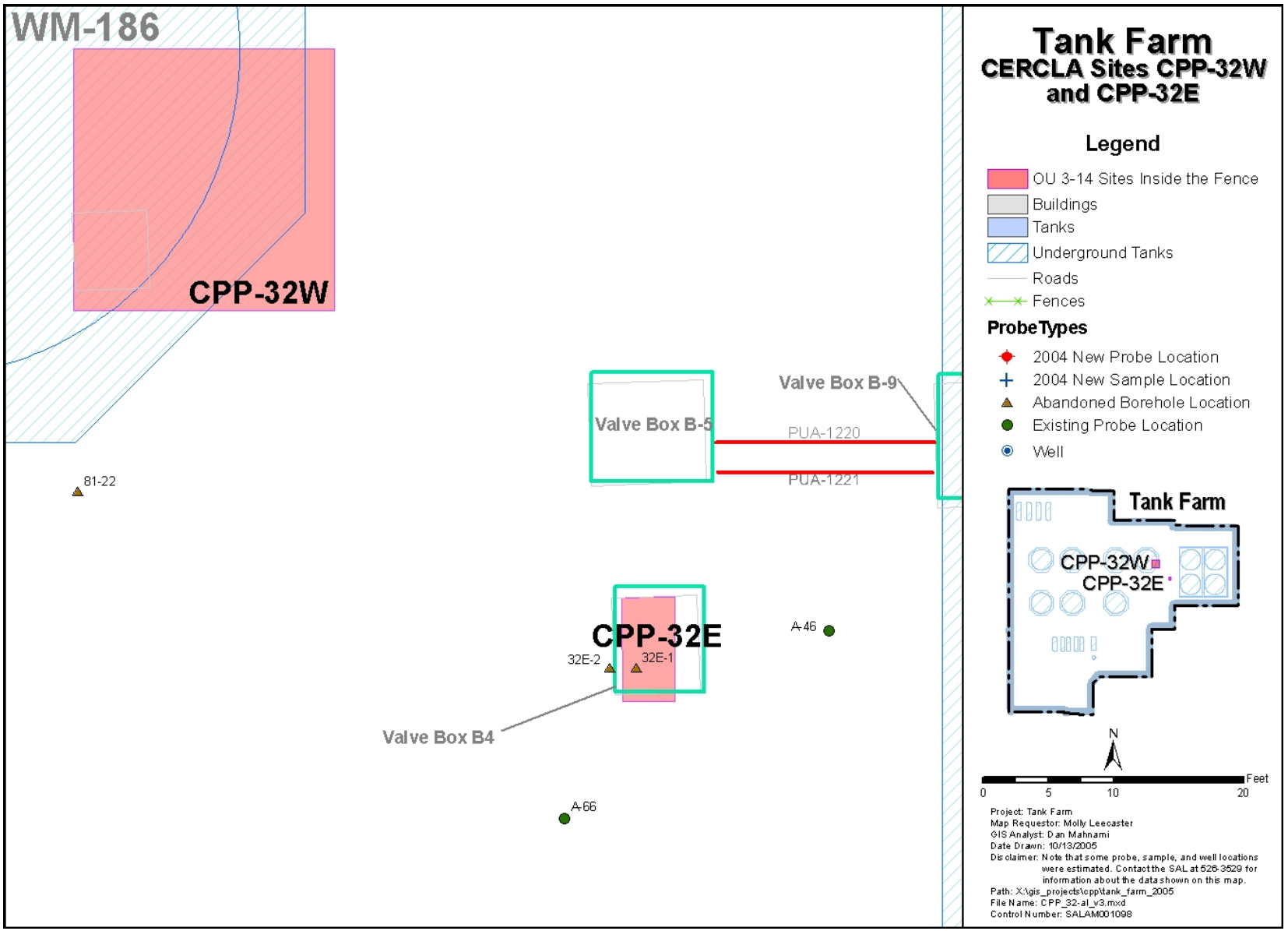

Figure 5-37. Detailed map of CPP-32E and CPP-32W.

inspection/sample tube would have been relatively small, much less than a gallon. Having a larger waste volume with higher activity, the CPP-24 soil should have been more highly contaminated than the CPP-32E soil. However, the contaminated soil at CPP-24 had a much lower radiation reading (400 mR/hr) than the B-4 soil contamination (2 R/hr). This suggests another mechanism may have contaminated Site CPP-32E.

There is a plausible explanation for the CPP-32E contamination. In the 1970s the tank farm valve box and tank vault sumps were occasionally inspected and their contents sampled to detect waste leaks. On December 9, 1976, routine monitoring of Box B-4 revealed liquid in the sump of the box (Lohse 1976). The liquid was sampled and its analysis indicated a waste leak had occurred. Subsequent investigation and testing found none of the valves in B-4 were leaking. Instead, a valve in Box B-2 was leaking. A portion of the Box B-2 secondary containment drained to Box B-4, accounting for the presence of waste in the Box B-4 sump. The leaking valve in Box B-2 was repaired without incident. No soil or personnel contamination or other unexpected problems occurred with the Box B-2 work.

The valve leak in December 1976 was discovered by analyzing a liquid sample obtained from Box B-4. The sample was obtained by lowering a sample bottle on a cable into the valve box sump via the inspection/sample port. After filling with liquid, the sample bottle was retrieved by pulling it up through the inspection/sample port. When the sample reached the top of the inspection/sample port, it was transferred into a small, shielded cask and transported to the Remote Analytical Facility. The sampling process wetted the exterior of the sample bottle with liquid from the sump. Some of that liquid dripped or was rubbed off the bottle and contaminated the inspection/sample port as it was withdrawn from the valve box. This could result in a contaminated inspection/sample port (standpipe) as described in Ison (1976). In addition, a few drops of liquid may have fallen off the bottle while it was transferred to the shielded cask. Some of the liquid inside the bottle could have inadvertently spilled if the bottle was tipped during handling. Blotter paper was typically installed on the ground during such operations. However, if the blotter paper had a tear or gap or if the liquid soaked through the blotter paper, the liquid would contaminate the soil near the sample/inspection port, as described in Ison (1976).

The contamination was found in late December 1976. The tank farm was subjected to periodic radiological surveys, so the contamination was relatively new. The leak in Box B-2 and sampling of the sump in Box B-4 occurred in early December 1976. If vapor condensation in the inspection/sample port were the source of soil contamination, then there should have been a valve leak in Box B-4 to account for the contamination near Box B-4. Alternatively, there should have been soil contamination due to condensation near the Box B-2 inspection/sample port, where a valve leak occurred. However, neither of these events occurred. The most plausible cause of the contamination near the Box B-4 inspection/sample port was drips or spills from handling the Box B-4 sump sample. Those activities occurred in early December 1976 and would have been detected in a late December 1976 routine radiological survey.

The waste that leaked in Box B-2 and drained into Box B-4 was high-activity, first-cycle raffinate. Contamination from such waste would have caused higher radiation readings than condensed vapors. This would explain why the contaminated soil near B-4 had higher radiation readings than the contaminated soil near WM-180 (Site CPP-24) that was caused by condensed vapors.

Though no readily available documentation exists, based on historical practice, the bulk of the contaminated soil was likely removed and the area decontaminated soon after its discovery. Documents indicate the discovery was likely a few weeks after the incident occurred.

5.12.1.2 Waste Source Term. The waste that leaked from the valve in Box B-2 was first-cycle coprocessing waste that was being transferred from WM-185 to the WCF for calcination. Samples of the waste were taken and analyzed in 1971 when the waste was initially produced and sent to the tank and

again in 1975 when calcination of the waste began. Rhodes (1972) documents the waste composition in 1971. The waste was the same type of waste (coprocessing) as that hypothesized to have created the contamination at Site CPP-28. The CPP-28 waste source term (Wenzel 2004) could be applied to the CPP-32E site assuming the waste had a Cs-137 activity of 1 Ci/L. The nitrate content of first-cycle coprocessing waste was about 2.4 molar.

5.12.1.3 Waste Volume Released. The volume of waste released to the soil is unknown, but it is limited to a small amount by the physical configuration of the plant equipment. The sample bottle used to obtain a sample from the sump of the valve box had a capacity of 15 mL, which would be the volume released if an entire bottle spilled. However, inadvertently spilling a full bottle of first-cycle raffinate would likely have been noticed and reported. No reports of such an event exist. It is more likely that the sample was successfully obtained and a few drops of solution dripped (unnoticed) from the outside of the bottle or were lost when the sample was tipped and some waste spilled onto the ground. The volume of waste released by such a scenario would be very small, perhaps 1-3 mL.

5.12.1.4 Source Term Summary. Site CPP-32E was likely contaminated in December 1976 with liquid that dripped from the equipment used to sample liquid in the Valve Box B-4 sump. At the time, first-cycle coprocessing raffinate had leaked from a valve in Box B-2 and drained into the Box B-4 sump. The amount of liquid that contaminated the soil was very small, about 1 to 3 mL. Although the waste was high in activity (about 1 Ci/L Cs-137), the small volume released reduced the activity in CPP-32E to amounts insignificant in additive terms compared with other tank farm contamination sites. For comparison, 100 to 300 gal (about 1,000 L) of the same type of waste leaked to the soil at Site CPP-28. Site CPP-28 was thus contaminated by five to six orders of magnitude more activity than Site CPP-32E. Table 5-36 shows the activity and nitrate released by the equivalent of 2 mL of coprocessing waste based upon the coprocessing waste (Wenzel 2004) source term. Most of the activity released was likely removed a few weeks after the release occurred.

5.12.2 Cleanup

No formal documentation was found describing cleanup of this site after it was identified in 1976. However, standard tank farm practice would have been to remove the contaminated soil. Because the amount of contaminated soil was relatively small, no records were likely kept. The site has since been covered with 2.5 ft of soil and the tank farm membrane, which was installed in 1977.

5.12.3 Previous Investigations

During the OU 3-07 Track 2 investigation in 1992 (WINCO 1993), soil samples from Site CPP-32E were collected from a single soil boring. The borehole was drilled adjacent to the vent tube until a concrete valve box was encountered at a depth of 5 ft.

During field screening, the highest beta/gamma radiation reading, 900 cpm above background, was detected between 1.4 and 2.9 ft below the membrane, which is about 2.5 ft below the current ground surface. This depth is roughly equivalent to the ground surface at the time of the release. These low contamination levels support the idea that the contaminated soil was removed when it was initially discovered in 1976. At the bottom of the borehole, the beta-gamma radiation had decreased to 250 cpm

Table 5-36. Estimate of major radionuclides and nitrate released at Site CPP-32E.

Cs-137	Sr-90	H-3	Tc-99	I-129	NO_3
2 mCi	2 mCi	2 μCi	0.3 μCi	0.4 nCi	0.0003 kg

above background. On the basis of the field radiation measurements, one soil sample was collected at a depth of 1.4 to 2.3 ft, and two soil samples were collected at a depth of 2.2 to 2.9 ft below the membrane. The samples were analyzed for VOCs, two metals (mercury and cadmium), gamma-emitting radionuclides, gross alpha and gross beta radiation, and Sr-90. Sample results are presented in Table 5-37.

The gross alpha concentrations from the three samples ranged from 14.8 to 21.5 pCi/g and were within normal background concentrations. Therefore, no isotopic analysis of the alpha-emitting radionuclides was performed. The gross beta concentrations from the three samples ranged from 350 to 724 pCi/g, and the subsequent isotopic analysis of Sr-90 ranged from 153 to 278 pCi/g. Of the man-made gamma-emitting radionuclides, only Cs-137, at concentrations ranging from 133 to 277 pCi/g, and Eu-154, at concentrations ranging from 0.456 to 0.811 pCi/g, were detected.

Table 5-37. Analytical results for soil samples collected at Site CPP-32E.

	Borehole CPP-32E-1		Borehole CPP-32E-1		Borehole CPP-32E-1	
	Depth (ft) 1.4 – 2.3		Depth (ft) 2.2 – 2.9		Depth (ft) 2.2-2.9 (Duplicate)	
	Sample No. 30701001		Sample No. 30701101		Sample No. 30701201	
Chemical Parameters	Concentration mg/kg or pCi/g	Q[a]	Concentration mg/kg or pCi/g	Q	Concentration mg/kg or pCi/g	Q
Toluene	0.001	J[b]	0.001	J	0.001	J
Mercury	0.22		0.3		0.16	
pH	9.27		9.26		9.36	
Radionuclides	Uncertainty	Q	Uncertainty	Q	Uncertainty	Q
Gross alpha	19.6 ± 2.63	J	21.5 ± 2.97		14.8 ± 2.1	
Gross beta	724 ± 58.6		358 ± 29.2		350 ± 28.7	
Cs-137	277 ± 21.1	J	151 ± 12.7		133 ± 11.2	
Eu-154	0.45 ± 0.066	J	0.81 ± 0.092		0.54 ± 0.076	
K-40	18.6 ± 0.99	J	18.7 ± 1.12		21.0 ± 1.13	
Sr-90	278 ± 14.6	J	152 ± 9.56		244 ± 14.1	
U-234	NA[c]		NA		NA	
U-235	NA		NA		NA	
U-238	NA		NA		NA	
Pu-238	NA		NA		NA	
Pu-239	NA		NA		NA	
Pu-242	NA		NA		NA	
Am-241	NA		NA		NA	

a. Q = qualifier.
b. J = estimated concentration (below MDL).
c. NA = not analyzed.

The installation of A-66 southwest of the valve box helped to bound the contamination at CPP-32E. The borehole was advanced to basalt and encountered no detectable contamination during field screening. A soil sample collected at the 40.3- to 42.3-ft depth interval had a gross alpha level of 26 pCi/g and a gross beta level of 29 pCi/g. Uranium-234 and U-238 were also detected in the sample at concentrations of 1.53 and 1.61 pCi/g, respectively. These results helped determine that the release at CPP-32E was not extensive and did not contaminate soil to the south and west of the release point.

5.12.4 Contamination Remaining in Alluvium

5.12.4.1 Nature of Contamination. The soil contamination was most likely removed and sent to the RWMC when discovered. Contaminant concentrations observed in 1992 are indistinguishable from contaminated backfill used throughout the tank farm. The site is entirely contained within CPP-96, and Section 5.18 discusses expected contaminant concentrations at backfilled sites.

5.12.4.2 Vertical Extent. The vertical extent of any remaining contamination at this site is entirely contained within CPP-96. The entire contaminated interval was most likely excavated and backfilled. Vertical extent is addressed in Section 5.18 for CPP-96.

5.12.4.3 Areal Extent. The areal extent of contamination at this site is entirely contained within CPP-96 and is discussed in Section 5.18.

5.12.4.4 Remaining Curies. The contamination was reportedly removed at the time the release was discovered; therefore, essentially none is estimated to remain. Contaminant inventory in backfill and alluvium for CPP-96 is discussed in Section 5.18.

5.12.5 Uncertainties/Data Gaps

No significant data gaps remain for this site. The extent, distribution, and composition of contamination originally released and remaining are adequately known to complete the BRA and FS.

5.12.6 References

DOE-ID, 2004, *Operable Unit 3-14 Tank Farm Soil and Groundwater Remedial Investigation/ Feasibility Study Work Plan*, DOE/ID-10676, Rev. 1, U.S. Department of Energy Idaho Operations Office, June 2004.

Ison, C. W., Allied Chemical, to Decommissioning File, December 30, 1976, "Additional Areas of Contaminated Soil Located on the Tank Farm," Document ID 27218, Alternate ID 003728.

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Rhodes, D. W., Allied Chemical Corporation, to Distribution, August 7, 1972, "Composition of First- and Second-Cycle Wastes," Rhod-4-72.

Wenzel, D. R., 2004, "Assessment of Radioactivity in INTEC Soil Contamination Site CPP-28," EDF-5318, Rev. 0, Idaho Completion Project, Idaho National Engineering and Environmental Laboratory, November 2004.

WINCO, 1993, *Track 2 Summary Report for Operable Unit 3-07 (Tank Farm Area I)*, Rev. 2, Westinghouse Idaho Nuclear Company, Inc., May 1993.

5.13 CPP-32W

CPP-32W is the result of a release of 1 gal of slightly contaminated water from a temporary, aboveground piping system. It is located near tank WM-186 (see Figure 1-2).

5.13.1 Description of Release

CPP-32W (see Figure 5-37, Figure 1-2) was likely contaminated by a release of approximately 1 gal of slightly contaminated water from a temporary, aboveground piping system that existed in the mid-1970s. The temporary piping system was used to transfer water from the vaults of the 300,000-gal tanks to the PEW evaporator feed collection system. The vault waste was primarily surface water that had leaked into the vault through joints in the vault roofs. The vault water was contaminated by small amounts of waste that drained into the vault from nearby valve boxes.

5.13.1.1 Background of System Configuration and Waste Release. Site CPP-32W is located over the southwest edge of the WM-186 tank vault. The contamination at Site CPP-32W was discovered in December 1976 (Ison 1976). Site CPP-32W has no permanently installed waste transfer piping that leaked. Instead, the cause of the contamination was residue leaking from a "temporary," aboveground, piping system used to transfer water from the tank vaults to the PEW evaporator for concentration. The bulk of the water came from storm water and snowmelt, but it was slightly contaminated due to drainage from valve boxes that contained occasional valve leaks. The temporary system was the "2-inch above ground line" noted in Ison (1976). The system was constructed of 2-in. pipe with threaded couplings, fittings, and unions so that it could be easily connected to and disconnected from a portable vault sump pump (steam jet) and also moved to allow vehicular traffic through the tank farm area. When the piping was disconnected, blotter paper and plastic bags taped over the ends of the pipe prevented residual liquid in the pipe from draining onto the ground. CPP-32W is located in an area where the end of a section of the temporary piping system lay when it was disconnected for vehicular traffic. Residual liquid likely ran out of the pipe and onto the ground, contaminating the soil at Site CPP-32W. Though no specific details of any soil cleanup are readily available, INTEC work practices at the time would have removed the contaminated soil from the area to reduce personnel radiation exposure and minimize the spread of contamination.

The original design of the INTEC tank farm included provisions to contain, collect, and transfer waste that leaked from a tank. The tank vaults were built to collect waste in one or more sumps. The contents of a vault sump could be jetted back into the waste tank, and the contents of a leaking tank could be transferred to another tank, if a problem such as a leak were to occur. The INTEC tank farm design assumed very little surface water existed at INTEC. Consequently, surface water infiltration into the tank vaults was assumed to be negligible, and little effort was made to waterproof the vaults. Thus, there were no provisions to handle surface water that leaked into the tank vaults separately from waste that might leak from a tank or valve.

After the tank farm was built and placed in operation, water infiltration (from snowmelt and rainfall) into the tank vaults became a problem. Surface water leaked into the tank vaults through the joints in the vault roofs and had to be removed from the vault. The tank vaults also received a small amount of waste from nearby valve boxes. If a valve leaked, the waste drained from the valve box into the tank vault. This contaminated the surface water that leaked into the vault. The result was a large amount (several tens of thousands of gallons annually) of slightly contaminated water in the tank vaults. The tank farm design provided the capability to transfer the contaminated vault water into the waste tank. However, this resulted in using a relatively large portion of the limited tank farm capacity to store dilute, low-activity waste (vault water), instead of the concentrated, high-activity waste for which it had been designed. Addition of the dilute waste to the tanks also made waste calcination more difficult. A major

tank farm upgrade in 1977 added a permanent piping system that could remove the dilute, low-activity waste from the tank vaults and transfer it to the PEW evaporator system. However, before that project was completed, a "temporary" system was installed to perform the same function.

In 1973, a temporary, aboveground, piping system was installed that ran across the tank farm in an east/west direction and connected to a permanent line near CPP-712 that led to the PEW evaporator feed collection tank, WL-102. A portable steam jet assembly was used to pump water from the tank vaults to the aboveground piping system and then to the PEW evaporator. The steam jet assembly was moved from one tank vault to another to remove water from the various tank vaults. This required connecting and disconnecting the steam jet assembly from the temporary piping system each time it was moved. At times, sections of the temporary piping were disconnected and moved aside to allow vehicular traffic to go through the tank farm area. This allowed cranes, trucks, and other equipment into the area to remove hatches, obtain samples, perform maintenance work, etc. Repeatedly disconnecting and connecting the steam jet and the temporary piping provided a mechanism for residual waste to drip out of the temporary piping and onto the ground. Site CPP-32W is located where one end of a section of the temporary piping rested when it was moved for vehicular traffic. It is likely the plastic covering typically used to cover the end of the open pipe had a hole in it or tore while resting on the ground, allowing residual liquid in the pipe to leak to the soil.

5.13.1.2 Waste Source Term. The waste released at CPP-32W was contaminated water from the tank vaults. The contamination came from leaking valves in valve boxes that drained into the tank vaults. Additionally, some waste siphoned from Tanks WM-185 and WM-187 into the tank vaults in 1962, contaminating those tank vaults. The activity of the water in the vaults depended on the volume and activity of the leaks in the nearby valve boxes, the amount of surface water that leaked into the vault, etc. The most commonly transferred waste was first-cycle raffinate; thus, it was the type of waste most likely to leak into a valve box. A sample (log number 76-4532) was taken of the water in the WM-187 vault in August 1976, a few months before the contamination at CPP-32W occurred. It was typical of vault sump water. The sample contained 2.37×10^4 d/s/mL Cs-137 (0.64 mCi/L or 2.42 mCi/gal). This activity was about three orders of magnitude lower than first-cycle raffinate, showing the relatively large amount of surface water infiltration compared to the amount of waste that leaked into the tank vault. The other radionuclides of concern, Sr-90, H-3, Tc-99, and I-129, were not included in the analyses of tank vault water. They can be estimated by assuming the contamination came from first-cycle coprocessing waste, the same as CPP-28 (Wenzel 2004). This yields the following activity estimates:

Cs-137 = 2.42 mCi/gal (sample analysis)

Sr-90 = 2.32 mCi/gal

H-3 = 1.96 μCi/gal

Tc-99 = 0.387 μCi/gal

I-129 = 0.532 nCi/gal.

Nitrate analyses were usually not performed on the vault water samples, so the nitrate content of the waste must be estimated. The Cs-137 activity noted above was about three orders of magnitude below that of typical first-cycle raffinate. Assuming the same nitrate dilution yields an estimated nitrate concentration of 0.003 molar.

5.13.1.3 Waste Volume Released. The waste volume that leaked is not known. The temporary piping was configured so that it sloped from east to west as it went toward the PEW evaporator feed collection tank. Thus, the bulk of the waste in the pipe drained from the pipe following a waste transfer, leaving little residue in the pipe. Site CPP-32W is described (DOE-ID 2004)) as being very small, only 6 ft^2 in size, further evidence that the leak was small in volume. A gallon is a conservatively high estimate of the volume of liquid that may have been inside the pipe and leaked onto the ground at Site CPP-32W.

5.13.1.4 Source Term Summary. CPP-32W was likely contaminated by a release of approximately 1 gal of slightly contaminated water from a temporary, aboveground piping system that existed in the mid-1970s. Assuming a release of 1 gal of waste with the previously described source term results in the contaminant releases given in Table 5-38.

5.13.2 Cleanup

No formal documentation was found describing cleanup of this site after it was identified in 1976. However, standard tank farm practice would have been to remove the contaminated soil. Because the amount of contaminated soil was relatively small, no records were likely kept. This site has since been covered with 2.5 ft of soil and the tank farm membrane, which was installed in 1977.

5.13.3 Previous Investigations

This area is approximately 6 ft^2, but the depth of contamination was not determined. CPP-32W was identified in December 1976 and described as having surface radiation levels up to 2 R/hr.

5.13.4 Contamination Remaining in Alluvium

5.13.4.1 Nature of Contamination. The soil contamination was most likely removed and sent to the RWMC when discovered. The site is entirely contained within CPP-96, and Section 5.18 discusses expected contaminant concentrations at backfilled sites.

5.13.4.2 Vertical Extent. The vertical extent of contamination at the time of the release was not described; however, the contaminated soil is assumed to have been removed. The vertical extent of any remaining contamination at this site is entirely contained within CPP-96. Vertical extent is addressed in Section 5.18 for CPP-96.

5.13.4.3 Areal Extent. This area, described at the time of the release, is approximately 6 ft^2, but the depth of contamination was not determined. The areal extent of contamination at this site is entirely contained within CPP-96 and is discussed in Section 5.18.

5.13.4.4 Remaining Curies. The contamination was reportedly removed at the time the release was discovered; therefore, essentially none is estimated to remain. Contaminant inventory in backfill and alluvium for CPP-96 is discussed in Section 5.18.

Table 5-38. Estimate of major radionuclides and nitrate released at Site CPP-32W.

Cs-137	Sr-90	H-3	Tc-99	I-129	NO_3
2.42 mCi	2.32 mCi	1.96 μCi	0.387 μCi	0.532 nCi	0.00007 kg

5.13.5 Uncertainties/Data Gaps

No significant data gaps remain for this site. The extent, distribution, and composition of contamination originally released and remaining are adequately known to complete the BRA and FS.

5.13.6 References

DOE-ID, 2004, *Operable Unit 3-14 Tank Farm Soil and Groundwater Remedial Investigation/ Feasibility Study Work Plan*, DOE/ID-10676, Rev. 1, U.S. Department of Energy Idaho Operations Office, June 2004.

Ison, C. W., Allied Chemical, to Decommissioning File, December 30, 1976, "Additional Areas of Contaminated Soil Located on the Tank Farm," Document ID 27218, Alternate ID 003728.

Wenzel, D. R., 2004, "Assessment of Radioactivity in INTEC Soil Contamination Site CPP-28," EDF-5318, Rev. 0, Idaho Completion Project, Idaho National Engineering and Environmental Laboratory, November 2004.

5.14 CPP-58

Site CPP-58 contains three locations where piping containing PEW evaporator condensates failed. The site is outside the tank farm southwest of Building 604 (Figure 5-38). A fourth release described briefly here occurred under Building CPP-649 in 1975 and is part of Site CPP-87/89 under Group 2 (Soils Under Buildings) in OU 3-13. The Group 2 leak is similar waste to the CPP-58 releases and information from the Group 2 leak was used to develop the source term for CPP-58. Additionally, the source term for the release under Building CPP-649 was not included in the CPP-87/89 source term that was developed for OU 3-13 (DOE-ID 1997) because it was not estimated until 2004. It is included in the OU 3-14 model as a new estimate for an OU 3-13 site.

5.14.1 Description of Release

Site CPP-58 (Figure 5-38) covers a relatively large area (14,190 acres) southwest of Building CPP-604. DOE-ID (2004) describes leaks in CPP-58 differently from the OU 3-13 documents, including the ROD (DOE-ID 1999) due to errors in the earlier documents. DOE-ID (2004) describes one of the leaks that contaminated the soil in CPP-58 (CPP-58E 1976 leak). A New Site Identification form (2005) describes two more leaks that contaminated the soil in CPP-58 in 1977 and 1980 (CPP-058 2005).

5.14.1.1 Background of System Configuration and Leak. The first leak that occurred in the area was in October 1975 under Building CPP-649 and is part of CPP-87/89, which is a Group 2 site (Soil Under Buildings) in OU 3-13. A portion of Line PLA-2069, which was used to transfer PEW evaporator condensate to the service waste system, leaked beneath the newly constructed Atmospheric Protection System (APS) building, CPP-649 (Figure 5-39). The cause of the line failure was never determined because the line was beneath CPP-649 and was never recovered for inspection. The leaking pipe contained both contaminated PEW evaporator process condensate and noncontaminated utility steam condensate, so not all of the leaking solution was contaminated. The leaking portion of pipe was abandoned and the evaporator condensate line was rerouted around Building CPP-649 after the leak was discovered. This leak was described in Swenson (2004) as one of two CPP-58E sites before the Agencies decided that it was more appropriate as a Group 2 site.

In September 1976, a leak occurred (CPP-58E) when an elbow in the evaporator condensate line PLA-2069 failed. The failure point was as a result of piping changes made in 1975 to reroute a line when it failed the year before. The 1976 failure was attributed to thermal stress. The line was rerouted to relieve the stress, repaired, and returned to service.

Another leak from underground line PLA-2069 occurred in Site CPP-58 in October 1977, based upon information in Operations monthly reports. The leak was west of Beech Street at an elbow in Line PLW-2069 where the line turns from a westerly to a northerly direction (see Figure 5-38). At the time, Line PLA-2069 was used to transfer PEW evaporator condensate from CPP-604 to the service waste system. The leak was discovered when leaking liquid was observed seeping through the surface of the soil. An excavation revealed a failed elbow in Line PLA-2069. The line was repaired and the system was returned to service.

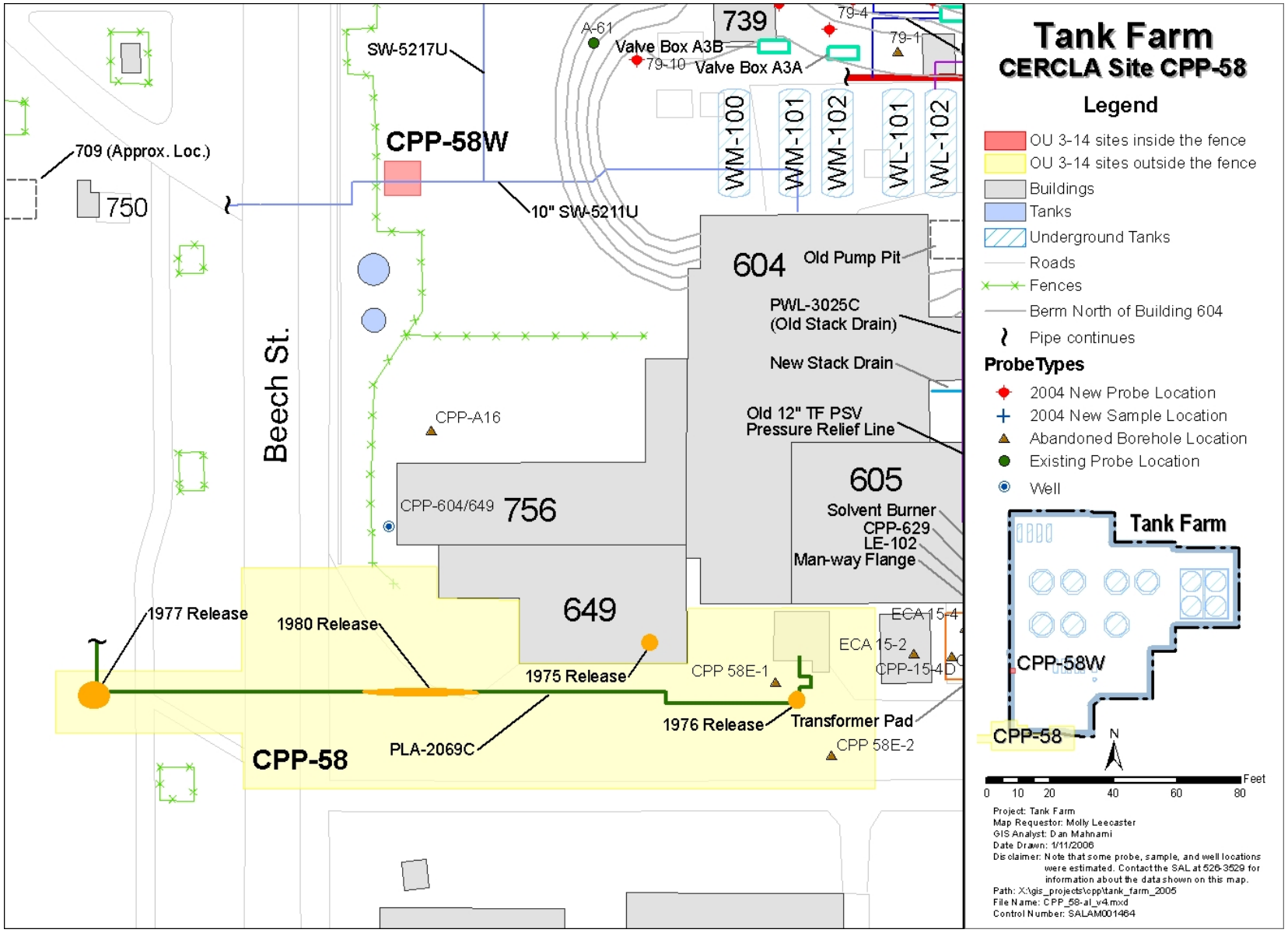

Figure 5-38. Detailed map of CPP-58.

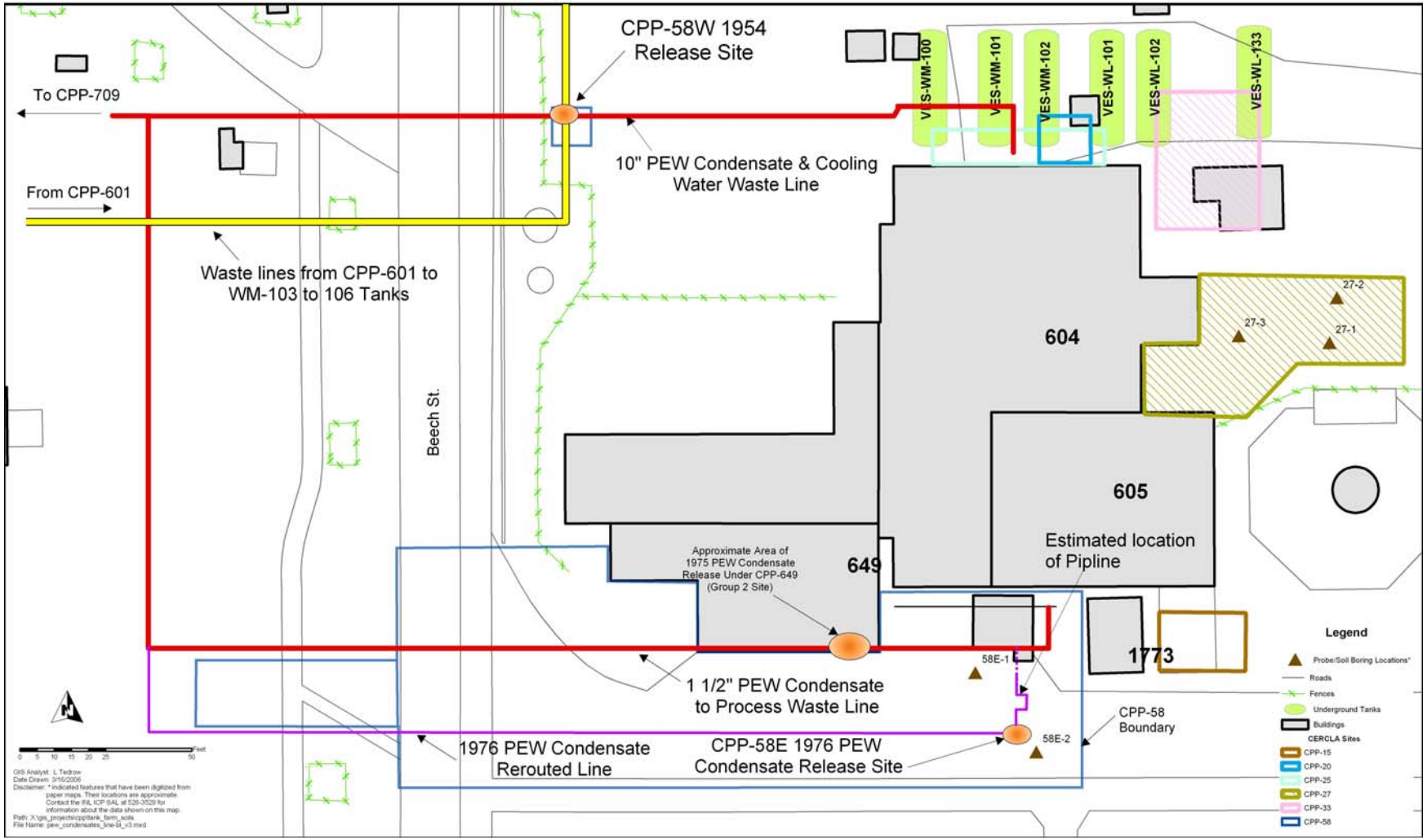

Figure 5-39. Map showing location of release site CPP-58, piping, and leak location.

A third leak from underground line PLA-2069 occurred in Site CPP-58 on August 19, 1980. The leak was just east of Beech Street and north of Olive Avenue. At the time, Line PLA-2069 was used to transfer PEW evaporator condensate from CPP-604 to the service waste system. The leak was discovered when leaking liquid was observed seeping through the surface of the soil. PEW evaporator condensate was being pumped from Vessel WL-106 to service waste at the time of the leak. After stopping the waste transfer, liquid stopped seeping out of the ground and the liquid that had accumulated on the soil surface immediately sank into the ground. An excavation revealed a failed elbow in Line PLA-2069. The elbow failed due to thermal stress. The line was repaired in a manner to reduce future thermal stresses and the system was returned to service.

5.14.1.2 Waste Source Term. The waste that leaked into Site CPP-58 was PEW evaporator condensate, which contained very low levels of radionuclides. In the 1970s through 1980, the contaminated process condensate from the PEW evaporator was collected in approximately 4,000-gal batches, sampled to assure the waste met disposal criteria, and then pumped to service waste. The composition of the individual batches of condensate that leaked is not readily available, but the activity for the major radionuclides sent to service waste for month-long intervals is available. Since the PEW evaporator process condensate was the only routine source of activity to the service waste, the service waste radionuclide data were also the PEW evaporator condensate data and can be used to estimate the activity leaked to Site CPP-58.

The Group 2 leak occurred in October and November 1975. During those 2 months, the Operations monthly reports indicate a total of 378,700 gal of evaporator process condensate were produced and sent to service waste. A fraction of that amount was released to the environment under Building CPP-649. The service waste discharge reports indicate a total of 61.6 mCi of Cs-137 and 51.3 mCi of Sr-90 were sent to service waste during those 2 months. On average, this represents a source term of 1.63×10^{-4} mCi/gal of Cs-137 and 1.35×10^{-4} mCi/gal of Sr-90 in the evaporator condensate. The activity of I-129 in the service waste was not reported in 1975. However, in subsequent years when I-129 analyses were performed, the amount of I-129 was generally about 1/10,000 of the amount of H-3 (although that value varied considerably over time). During October and November 1975, 13,573 mCi of H-3 (3.6×10^{-2} mCi/gal) were sent to service waste. Use of the 10,000:1 ratio for H-3:I-129 results in a source term of 1.36 mCi, or 3.6×10^{-6} mCi/gal I-129 in the evaporator condensate. The value of 1.36 mCi for I-129 in the service waste over a 2-month period is reasonable in comparison with historical data for which I-129 activities are available.

There are no data for the Tc-99 activity in the service waste or PEW evaporator condensate for any operating period. However, Tc-99 is found in many of the SRPA monitoring wells in and south of INTEC. The PEW evaporator condensate was the primary source of most of the radioactivity in the service waste and hence the aquifer. Therefore, the relative activity of mobile radionuclides, such as Tc-99 and I-129, in the PEW evaporator condensate should be similar to those in the aquifer. The activities and ratios of I-129 and Tc-99 in the aquifer vary from well to well. The ratio of Tc-99:I-129 varies from a value of about 10 in a series of "LF" wells located just north of CFA to a value of about 100 in the USGS wells located in the area within and immediately south of INTEC (DOE-ID 2002). Assuming Tc-99 and I-129 are equally mobile in the aquifer and both came from the PEW evaporator condensate, the Tc-99 activity in the PEW evaporator condensate that leaked in 1975 was between 3.6×10^{-5} and 3.6×10^{-4} mCi/gal (10 to 100 times the I-129 activity). The ratios in the "LF" wells near CFA (which yield 3.6×10^{-5} mCi/gal) may be more representative of historical PEW evaporator and service waste activity ratios as they represent older waste that has migrated south of INTEC with the flow of the aquifer. The higher Tc-99:I-129 ratio found in wells closer to INTEC may be influenced by contaminant migration from the tank farm soils or other non-PEW evaporator/service waste sources that contain higher ratios of Tc-99:I-129.

A waste source term can be developed for the 1976 CPP-58E leak in a manner similar to that of the 1975 leak. During September 1976, 193,400 gal of evaporator condensate were sent to service waste, a portion of which leaked to the soil. The service waste contained 20 mCi of Cs-137, 7.1 mCi of Sr-90, 521 mCi of H-3, and 1.24 mCi of I-129. This corresponds to activity concentrations of 1.03×10^{-4} mCi/gal for Cs-137, 3.67×10^{-5} mCi/gal for Sr-90, 2.7×10^{-3} mCi/gal for H-3, and 6.41×10^{-6} mCi/gal for I-129 in the PEW evaporator condensate. As with the 1975 leak, there are no data for Tc-99. Assuming the Tc-99 activity was 10 to 100 times that of the I-129 means the Tc-99 was between 6.4×10^{-5} and 6.4×10^{-4} mCi/gal. The lower value (6.4×10^{-5} mCi/gal) is based on the aquifer samples from the LF wells near CFA and may be more representative of historical PEW evaporator condensate that migrated through the aquifer.

The nitrate content of the waste that leaked is also of interest for groundwater modeling purposes. The nitrate content of the PEW evaporator condensate varied between individual batches. Historical sample results show it was generally between 0.1 and 0.5 molar, averaging about 0.3 molar.

In October 1977, the Operations monthly report indicates a total of 281,000 gal of evaporator process condensate were produced and sent to service waste. The service waste discharge reports indicate a total of 31.12 mCi of Cs-137, 12.89 mCi of Sr-90, 0.3499 mCi of I-129, and 59,270 mCi of H-3 were sent to service waste during that month. On average, this represents a source term of 1.11×10^{-4} mCi/gal of Cs-137, 4.59×10^{-5} mCi/gal of Sr-90, 1.25×10^{-6} mCi/gal I-129, and 0.211×10^{-3} mCi/gal H-3 in the evaporator condensate.

In August 1980, the Operations monthly report indicates a total of 185,450 gal of evaporator process condensate were produced and sent to service waste. The service waste discharge reports indicate a total of 13.09 mCi of Cs-137, 13.5 mCi of Sr-90, 0.1939 mCi of I-129, and 341 mCi of H-3 were sent to service waste during that month. On average, this represents a source term of 7.06×10^{-5} mCi/gal of Cs-137, 7.28×10^{-5} mCi/gal of Sr-90, 1.05×10^{-6} mCi/gal I-129, and 1.84×10^{-3} mCi/gal H-3 in the evaporator condensate.

5.14.1.3 Waste Volume Leaked to Soil. There is considerable uncertainty about the amount of waste that leaked to CPP-58.

The CPP-58E (1976) leak was confined on three and a half sides by concrete structures (the INTEC utility tunnel and nearby Buildings CPP-604 and CPP-649) to a relatively small area (about 50 ft × 50 ft). Given the close confinement, a leak of 40,000 gal (total water) from a shallow line (5-6 ft below grade) over a short time would likely have appeared seeping through the soil surface, into the neighboring buildings or utility tunnel, etc., as occurred with the 1975 leak that leaked into CPP-649. However, no mention is made of such leakage in any of the reports on the line failure. This is likely because the leak was much smaller than the estimated value.

When DOE-ID (2004) was written, Site CPP-58E was recognized as being insignificant in terms of Cs-137 and Sr-90 contamination (a few millicuries) compared to other contaminated tank farm soils (such as CPP-31 where several thousand curies leaked). The estimated leakage of nearly 20,000 gal was an upper, conservative bound to determine whether more field data were needed. However, in order to use the data to calibrate a groundwater model, a more reasonable estimate of the leakage should be used.

The most likely piping failure scenarios for CPP-58E would result in small cracks in the piping, not catastrophic failures. Small cracks would allow small amounts of leakage under low pressure. A leakage of 1-2% of the waste flow is a more reasonable leak rate than the 20% assumed in DOE-ID (2004). The actual process leakage was likely a few hundred to a few thousand gallons. A leak of 500 to 5,000 gal (0.5 to 5% of the service waste) is a more reasonable estimate of the leak.

The piping and soil configurations for the 1977 leak are similar to those of the 1976 leak from Line PLA-2069. Those leaks were estimated at 2,500 gal each. Therefore, the October 1977 leak is also assumed to have been 1,500 gal.

The leaking pipe was bounded closely on two sides by the concrete utility tunnel, which prevented lateral migration of waste. Due to the speed at which the surface seepage started and stopped as the PEW condensate pump was started and stopped and the relatively shallow depth of the leaking line, there appears to have been a rapid and direct route to the surface of the soil. The leaked volume was likely relatively small, at most a few hundred gallons. A conservative assumption would be to assume 1,000 gal leaked into the soil.

5.14.1.4 Source Term Summary. CPP-58 was contaminated by three leaks of service waste, one each in 1976 (CPP-58E), 1977, and 1980. DOE-ID (2004) conservatively estimated the volume of the 1976 leak at approximately 20,000 gal. The volume estimates are likely several times higher than the amounts that actually leaked. The source term for Cs-137, H-3, and Sr-90 presented in this report came from monthly service waste disposal records. The estimate of the I-129 activity came from the monthly service waste records. The Tc-99 activity for both releases was estimated based upon radionuclide ratios found in the aquifer and in the service waste system. The nitrate concentration values were estimated from historical PEW evaporator condensate samples.

Table 5-39 summarizes the activity of major radionuclides and mass of nitrate released at Site CPP-58.

Table 5-39. Estimate of major radionuclides and nitrate released at Site CPP-58 and CPP-87/89 site under Building CPP-649.

Year	Cs-137	Sr-90	H-3	Tc-99	I-129	NO_3
1975 (CPP-87/89)	0.41 mCi	0.34 mCi	90 mCi	0.090 mCi	0.0090 mCi	176 kg
1976	0.26 mCi	0.094 mCi	6.8 mCi	0.16 mCi	0.016 mCi	176 kg
1977	0.278 mCi	0.115 mCi	527 mCi	0.0311 mCi	0.00311 mCi	176 kg
1980	0.0706 mCi	0.0728 mCi	1.84 mCi	0.0105 mCi	0.00105 mCi	70.4 kg

5.14.2 Cleanup

No record exists of any soil cleanup effort made at the time the leaks occurred. The area around the release location was excavated to a depth of 8 ft bgs to repair the pipeline (WINCO 1993). Soil cleanup likely did not occur due to the very low activity of the waste and corresponding low contamination of the soil. However, since that time, significant soil disturbance occurred with a variety of construction projects in the CPP-58 area.

5.14.3 Previous Investigations

As part of the 1992 Track 2 investigation for OU 3-11 (WINCO 1993), two boreholes were made at the CPP-58 site (see Figure 5-38). The locations of the boreholes were selected so that underground utilities would not be damaged. Borehole CPP-58E-2 was drilled to 12 ft bgs and was located approximately 30 ft southwest of the release. Borehole CPP-58E-1 was drilled to 46 ft bgs and was located within 12 ft of the release site. Plans called for samples to be collected from intervals exhibiting the highest gamma/beta radiation fields as measured with field instruments. However, no

radiation above background was detected in either borehole; therefore, samples that were representative of the entire drilled intervals were collected. Thirteen samples were collected from the two boreholes and analyzed for VOCs, selected metals (mercury and cadmium), fluoride, nitrate, nitrite, pH, and radionuclides. Tc-99 and I-129 were not analyzed for.

Sampling and analysis showed gross alpha activity ranged from 3.92 ± 0.67 to 24.4 ± 3.28 pCi/g. Only the sample collected from 8 to 10 ft in Borehole CPP-58E-1 exceeded the background activity of 20 pCi/g. Subsequent isotopic analyses for alpha-emitting radionuclides on this sample detected U-234 and -238 below background concentrations and Pu-238, U-235, Pu-239, and Am-241 above background concentrations.

Sampling and analysis results indicated that Cs-137 and Sr-90 were above background levels. The gross beta activity ranged from 31.3 ±2.78 to 271 ±22.1 pCi/g. Subsequent isotopic analysis for Sr-90 detected concentrations ranging from 0.877 ±0.276 to 33.4 ±3.17 pCi/g. In general, lower concentrations of Sr-90 were measured in Borehole CPP-58E-2 than in CPP-58E-1. This is expected because borehole CPP-58E-1 is closer to the location of the release. The results of the gamma analysis detected only Cs-137 and K-40. The concentrations of K-40 are within normal background ranges. Cs-137 activities ranged from 0.269 ±0.0211 to 63.1 ±4.57 pCi/g, with the higher concentrations detected at a depth of less than 22 ft in Borehole CPP-58E-1 and at depths less than 10 ft in Borehole CPP-58E-2.

Below 6 ft bgs, the primary contaminants detected were Cs-137 and Sr-90. This is consistent with the waste stream that was reportedly released. Cs-137 concentrations are generally higher than Sr-90 concentrations above 22 ft in Borehole CPP-58E-1 and above 12 ft in Borehole CPP-58E-2. Below these depths, Sr-90 concentrations are higher than Cs-137 concentrations. This relationship is believed to be the result of the greater mobility of Sr-90 relative to Cs-137, given that these two radionuclides were likely in roughly equal concentrations in the released condensate.

5.14.3.1 CPP-58 New Site Investigation. In April 2001, during Group 1 Tank Farm Interim Action (TFIA) field activities, a moist brown material (nitric acid contamination) was uncovered while excavating a trench for the TFIA drainage system along Olive Avenue, and slightly elevated levels of radiological contamination were discovered in soil while excavating a TFIA drainage system lift station near the intersection of Olive Avenue and Beech Street.

The area where the moist brown material was discovered is within the area previously identified as CPP-58 and is not likely related to the 1976 release (CPP-58E). The material was slowly seeping into the north wall of the trench as it was being excavated. The top of the seepage/stained area was approximately 6 ft bgs on the north trench wall and extended to the bottom of the trench at that time, a depth of approximately 7 ft. The seepage did not emit radiological activity.

Preliminary sampling and characterization identified the material as nitric acid, which exhibited a low pH (2.41) and the presence of nitrates (3.67 mg/mL). Other contaminants included 0.639 mg/kg of mercury and 6.98 pCi/g of Cs-137.

An attempt was made in 2001 to trace this “seep” back to a source (due to concerns that it could be an ongoing release from an active system) by excavating the moist soil areas. However, the moist discolored soil was in a small, localized area (approximately 1.5 ft in diameter). After removal of the moist soil, a much larger area was excavated and pipes exposed in an attempt to identify any leaking pipes or the source of the release. No leaking pipes or sources were found. The extent of the area excavated is bounded by the utility tunnels on the south and east, by the building/utilities on the north, and by the long trench excavation on the west (part of the TFIA) (see drawing in INEEL 2002). In review of the excavation and drawing, the source of the contamination was not evident, because no active nitric

acid lines or known abandoned lines were in the immediate area. In addition, an assessment identified no other release from the active systems in the area that might contribute to this release of nitric acid. To provide an indication of contamination remaining in the excavation after completion of the attempt to trace the "seep," composite samples of the dry soils were taken and tested for pH. The results ranged from pH of 1.9 to 8.7. No evidence of any further seepage was observed in the excavated area.

While excavating the lift station near the intersection of Olive Avenue and Beech Street, radiological contamination activities were typically between 200 and 300 cpm with a high of 500 cpm. The area of this excavation is to the south and west of CPP-58W. The highest project-measured level of contamination was 5,000 decays per minute, based on the 10% efficiency of the field meters. This correlates to 500 cpm. By assuming Cs-137 is the main source of radiation, the dose would be about 0.14 mR/hr and equate to an activity of roughly 22.8 pCi/g Cs-137 in the soil. Because the extent of contamination at CPP-58 is unknown and because of the discovered moist brown-stained soil (discussed above), the boundary of CPP-58 has been revised to include the area of CPP-58E and the area in the proximity to the lift station.

5.14.4 Contamination Remaining in Alluvium

5.14.4.1 Nature of Contamination. Essentially all of the contamination originally released is estimated to remain at this site. Sampling results discussed above are consistent with the conceptual model of release of PEW evaporator condensate, with the exception of the unrelated nitric acid contamination discussed above. However, the low concentrations of Cs-137 and Sr-90 observed in the 1992 sampling and analysis are indistinguishable from contaminated backfill used throughout the tank farm.

5.14.4.2 Vertical Extent. The service waste line from which the release occurred was at a depth of 6 ft bgs. Based on sampling records from the 1992 Track 2 investigation, Cs-137 was measured at 63.1 pCi/g at a depth of 16 ft bgs and at 2.14 pCi/g at a depth of 30-32 ft bgs in CPP-58E-1.

5.14.4.3 Areal Extent. The area of CPP-58, including the "New Site" discovered in April 2001, is conservatively estimated at 1.5E+04 ft^2.

5.14.4.4 Remaining Curies. Less than one-half of the 0.89 mCi of Cs-137 and Sr-90 estimated to have been released at CPP-58 remains, due to radioactive decay. The majority of the roughly 536 mCi of H-3, Tc-99, and I-129 likely no longer remains in the alluvium.

5.14.5 Uncertainties/Data Gaps

The extent, distribution, and composition of contamination originally released and remaining at CPP-58 are adequately known to complete the BRA and FS. However, better estimates of extent and distribution of contamination may be required during remedial design and remedial action, depending on the remedial alternative selected.

5.14.6 References

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DOE-ID, 2002, *Annual INTEC Groundwater Monitoring Report for Group 5—Snake River Plain Aquifer (2001)*, DOE/ID-10930, Rev. 0, U.S. Department of Energy Idaho Operations Office, February 2002.

DOE-ID, 2004, *Operable Unit 3-14 Tank Farm Soil and Groundwater Remedial Investigation/ Feasibility Study Work Plan*, DOE/ID-10676, Rev. 1, U.S. Department of Energy Idaho Operations Office, June 2004.

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Swenson, M. C., CH2M-WG Idaho LLC, to L. S. Cahn, CH2M-WG Idaho LLC, December 1, 2004, "Causes, Compositions, and Volumes of Waste Released at the INTEC Tank Farm in Contamination Sites CPP-28, -31, -58E, and -79," MCS-07-04.

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5.15 CPP-58W

Site CPP-58W is located between CPP-601 and CPP-604 just inside the tank farm boundary and is associated with a break in a service waste line.

5.15.1 Description of Release

Site CPP-58W is located in the yard about halfway between CPP-601 and CPP-604, due east of CPP-709 (Figure 5-39). A leak contaminated the soil in the area on August 30, 1954. The leak occurred when construction workers were excavating an area for a new piping run from CPP-601 to new waste storage tanks (WM-103 through -106) being constructed at the north end to the tank farm. The new construction included a north/south pipe trench that ran underneath the CPP-604 service waste line that ran in a westerly direction from the north end of CPP-604. The CPP-604 service waste line was an 8-in. concrete pipe that likely shifted slightly during the 1954 construction work to dig the pipe trench. A slight shift would cause cracks in the joints of the concrete pipe. In the original INTEC design, all of the service waste from CPP-604 was contained in the 8-in. concrete line. This included noncontaminated steam condensate and cooling water, as well as slightly contaminated PEW evaporator process condensate. Leaks from the service waste line would have included a continuous flow of noncontaminated water, with occasional spikes of radioactivity corresponding to those times when PEW evaporator condensate was pumped to service waste. A Radioactivity Incident Report (1960) and Operations weekly report (Reid 1954) both describe this release.

5.15.1.1 Background of System Configuration and Leak. The Radioactivity Incident Report indicates the contamination level was very low, 25 mR/hr on the pipe at the leaking joint and a slight amount of contamination in the water in the trench. This is consistent with contamination from low-activity PEW evaporator condensate.

5.15.1.2 Waste Source Term. There is no record of any soil or waste analysis corresponding to the leak. However, a source term can be estimated from monthly reports of the total activity sent to service waste in August 1954 and from historical service waste discharge records. The August 1954 Operations monthly report (Vance 1954) indicates 0.495 Ci of total activity went to service waste. Assuming that activity came from a volume of 125,000 gal of PEW evaporator condensate (average historical value) yields a total activity of 4.0 μCi/gal. The Operations monthly report indicates the bulk of the activity (66%) was short-lived Ce-144. It indicates 9% of the activity was Sr-89 and Sr-90. Conservatively assuming all Sr activity was Sr-90 and assuming the Cs-137 activity was similar to Sr-90 yield estimated activities of 0.36 μCi/gal for both Sr-90 and Cs-137. There are no analytical data for other radionuclides of interest, and they must be estimated. Historically, the H-3 activity in the service waste (from PEW evaporator condensate) was about 1,000 times higher than Cs-137, or about 0.36 mCi/gal. Historically, the activity of I-129 was about one-tenth that of Cs-137, or about 0.036 μCi/gal. There are no analytical data for Tc-99 in either the service waste or PEW evaporator waste. Its activity can be estimated by a ratio of 10 for Tc-99:I-129 found in the "LF" wells near CFA that presumably represent historical service waste discharges (DOE-ID 2002). This yields an estimate of 0.36 μCi/gal for Tc-99 activity in the PEW evaporator condensate.

The nitrate content of the evaporator condensate is not known, but a value of about 0.3 M is a reasonable estimate based upon historical data.

5.15.1.3 Waste Volume Leaked to Soil. There is no recorded estimate of the amount of waste that leaked into the new pipe trench. DOE-ID (2004) assumes a relatively small volume of contaminated condensate (37 gal) leaked. The estimate of the volume leaked depends upon one's assumptions. A plausible scenario is that the leak began and was observed by construction workers and checked by HP personnel. The construction workers requested Operations personnel shut down processes contributing water into the service waste system. This may have taken some time if the leak was very small, or it may have taken very little time if the leak was sufficiently large that it interfered with construction work in the trench beneath the tunnel. A leak of 1,000 gal of water (combined clean and contaminated streams) is a plausible upper limit for the amount of water that leaked. That amount would have affected construction work in the new pipe trench and forced workers to stop the flow of water in the leaking line. The contaminated condensate was about 10% (DOE-ID 2004) of the total flow in the CPP-604 service waste line (which also included noncontaminated steam condensate and cooling water). This results in an equivalent leak of 100 gal of contaminated evaporator condensate. This value is about three times higher than the 37-gal estimate in DOE-ID (2004). Considering the very low activity level of the waste, the difference in the two volumes is negligible in terms of impact to an overall tank farm source term.

5.15.1.4 Source Term Summary. Site CPP-58W was contaminated in August 1954 by a leak from a concrete pipe containing the CPP-604 service waste water. The service waste water included slightly contaminated PEW evaporator condensate, which provided the source of the contamination. The concrete pipe was likely damaged and began leaking when construction workers dug a trench beneath the pipe. The trench was part of a project to install new waste transfer lines and new tanks. The amount of waste that leaked is not certain, but it was likely not more than 1,000 gal and contained the equivalent of 100 gal of PEW evaporator condensate. Table 5-40 shows the contaminants released at Site CPP-58W assuming a leak of 100 gal of PEW evaporator condensate. Compared to releases in other tank farm sites, such as CPP-31, the activity released is not a significant source to the groundwater model. The activity of Cs-137 released at CPP-58W is nearly nine orders of magnitude less than activity released at CPP-31. Because

of the small amount of activity, further development of a detailed source term for CPP-25 is not recommended.

Table 5-40. Estimate of radionuclides and nitrate released at Site CPP-58W.

Cs-137	Sr-90	H-3	Tc-99	I-129	NO_3
36 μCi	36 μCi	36 mCi	36 μCi	3.6 μCi	7.0 kg

5.15.2 Cleanup

Although no specific mention of any cleanup is given in either the Operations report or the Radioactivity Incident Report, based on historical experience with similar incidents, it is likely at least some of the contaminated soil was removed to reduce radiation exposure to personnel working in the construction area. The leaking portion of the line was replaced by iron pipe.

5.15.3 Previous Investigations

Review of piping diagrams determined that the 1954 release, identified as Site CPP-58W, did not take place under Building CPP-649 as originally shown on figures in the Track 2 and OU 3-13 documents. This release actually occurred to the northwest of the CPP-58 site boundary, between Buildings CPP-601 and CPP-604 as described previously. Both the OU 3-13 ROD and the Track 2 Summary Report for Operable Unit 3-11 incorrectly defined the release that occurred in the area identified as CPP-58W as the 1954 release (DOE-ID 2004). Therefore, the actual release site was not investigated under either the Track 2 process or the OU 3-13 RI.

5.15.4 Contamination Remaining in Alluvium

5.15.4.1 Nature of Contamination. There is no record of any spill or waste analysis corresponding to the leak. The service waste water included slightly contaminated PEW evaporator condensate, and the leak contained a small amount of activity. It is likely at least some of the contaminated soil was removed to reduce radiation exposure to personnel working in the construction area when the leak was discovered. However, the nature and extent of contamination are unknown but expected to be insignificant.

5.15.4.2 Vertical Extent. The service waste line from which the release occurred was at a depth of 6 to 8 ft bgs. The vertical extent of any remaining contamination at this site is unknown but is entirely contained within consolidated backfill and soils inside the tank farm boundary discussed in Section 5.18.

5.15.4.3 Areal Extent. The areal extent of remaining contamination is unknown but is entirely contained within consolidated backfill and soils inside the tank farm boundary discussed in Section 5.18.

5.15.4.4 Remaining Curies. Less than one-half of the 72 μCi of Cs-137 and Sr-90 estimated to have been released at CPP-58W in 1954 remains, due to radioactive decay. The majority of the mobile constituents including an estimated 36 mCi of H-3, 36 μCi of Tc-99, and 3.6 μCi of I-129 released likely no longer remain in the alluvium. No records exist to document whether soil was removed from the excavation to protect construction workers, but it is likely that some was removed.

5.15.5 Uncertainties/Data Gaps

The extent, distribution, and composition of contamination originally released and remaining at CPP-58W are adequately known to complete the BRA and FS. However, better estimates of extent and distribution of contamination may be required during remedial design and remedial action, depending on the remedial alternative selected.

5.15.6 References

DOE-ID, 2002, *Annual INTEC Groundwater Monitoring Report for Group 5—Snake River Plain Aquifer (2001)*, DOE/ID-10930, Rev. 0, U.S. Department of Energy Idaho Operations Office, February 2002.

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5.16 CPP-79 (Shallow)

Site CPP-79 (shallow) is the site of low-activity contamination under the berm north of the CPP-604 tank vault caused by a leak of PEW evaporator feed solution.

5.16.1 Description of Release

Site CPP-79 covers a medium-sized area northeast of the CPP-604 tank vault (Figure 5-40). CPP-79 was likely contaminated by leaks from two different sources: a known source of PEW evaporator feed solution that caused low-activity contamination in a shallow area and a second, unknown, source that created high-activity contamination in a deeper area. The CPP-79 (shallow) release is described in this section, and the CPP-79 (deep) release is discussed in Section 5.17.

5.16.1.1 Background of System Configuration and Leak. DOE-ID (2004) indicates the shallow, low-activity contamination occurred in July and August 1986 when two waste transfers of PEW evaporator feed solution leaked to the soil. The event investigation (WINCO 1987) indicates waste was transferred to the PEW evaporator via a line connected to a gravity drain line from Valve Box A2. Figure 5-41 shows the physical configuration of the waste transfer lines, valve and junction boxes, and other encasements involved in the leak.

During waste transfers from the New Waste Calcining Facility (NWCF) and WCF, two closed valves caused waste solution to back up into Valve Box A2 via the valve box drain line. The waste flowed out of Valve Box A2 via the encasements surrounding transfer lines PUA-1013 and PUA-203 that entered the west side of Valve Box A2. The waste leaked to the soil through failed encasements. The exact location of the encasement failure was never determined. The pipe encasements included sections of stainless-steel pipe, split tile pipe, and two unlined/unsealed concrete junction boxes. The stainless-steel pipe-in-pipe encasement and one of the junction boxes were at an elevation about 9 ft below grade (not including the elevation of the berm north of CPP-604), which was just above the CPP-79 (shallow) contamination. The second junction box and the split tile portion of the encasement were about 29 ft below grade, which was just above the CPP-79 (deep) contamination site. The vertical piping between the upper and lower piping sections was encased in stainless-steel pipe-in-pipe encasement.

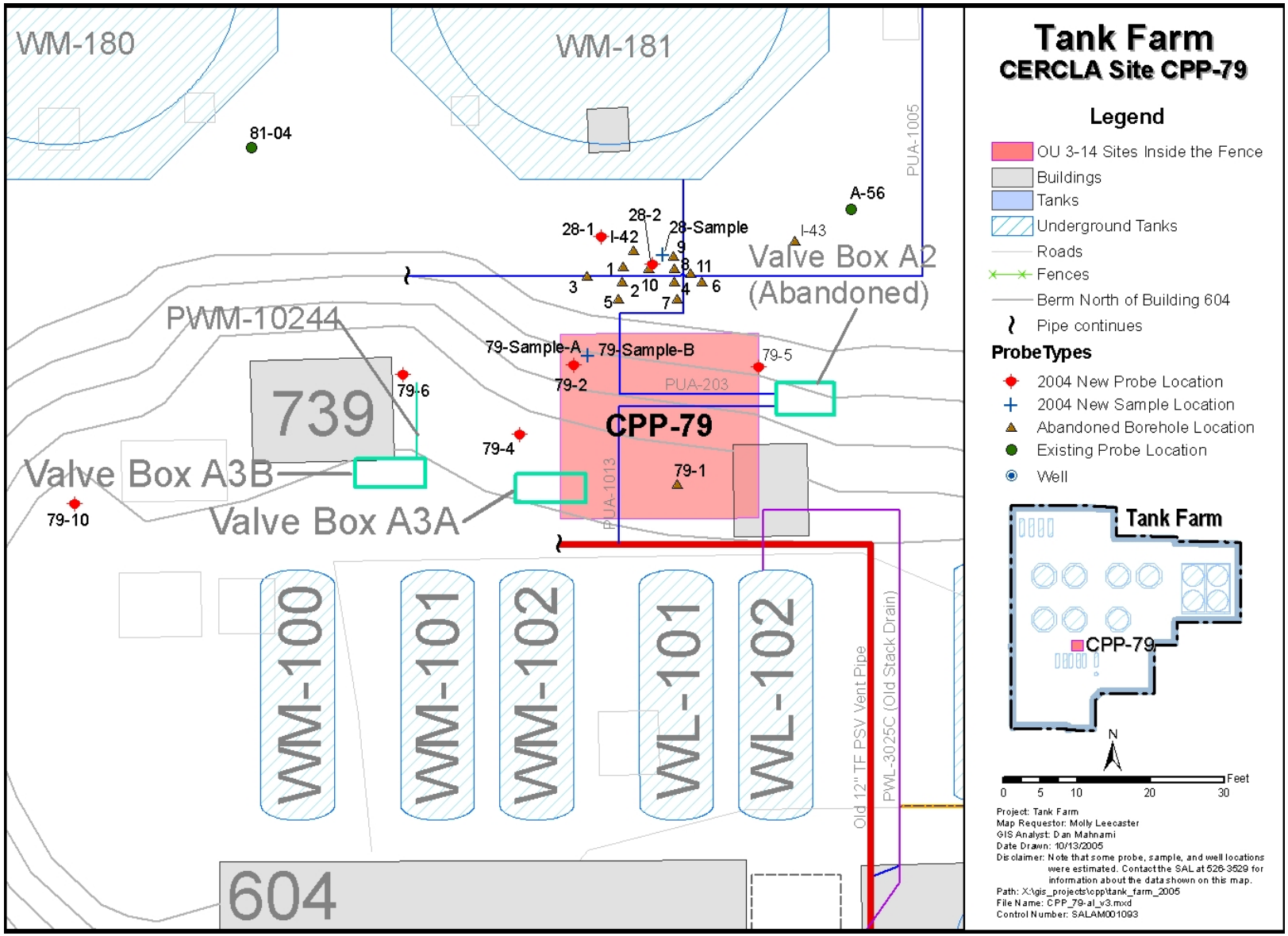

Figure 5-40. Detailed map of CPP-79.

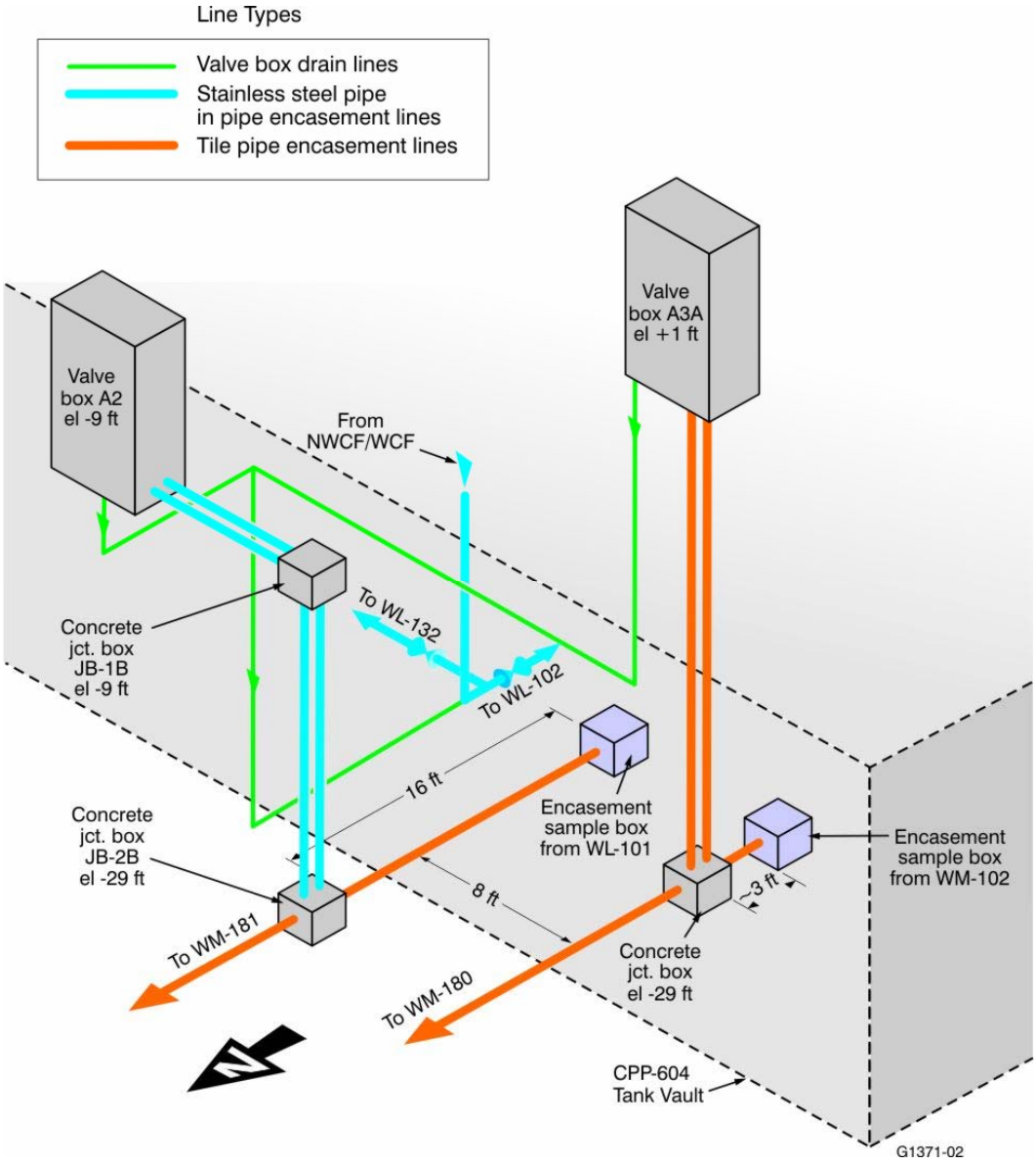

Figure 5-41. Schematic showing the configuration of waste transfer piping and valve boxes near the CPP-604 tank vault associated with Site CPP-79 contamination.

The portions of encasement most likely to leak were the concrete junction boxes and the split tile encasement. The tile encasement was originally installed in the early 1950s. It was excavated in the mid-1950s and modified by the installation of the lower concrete junction box. The piping inside the new junction box was modified to provide a route to the new (at the time) Valve Box A2. The excavation, modification, backfilling, and subsequent soil settling could have damaged the brittle tile encasement (or concrete junction boxes), resulting in leakage to the soil in 1986. The waste transfer lines whose encasements leaked (PUA-1013 and -203) were administratively removed from service at the time of the leak, which prevented additional soil contamination. The lines were physically removed during a tank farm upgrade project in the mid-1990s.

The waste that leaked in 1986 was low in radioactivity and created low-activity soil contamination; hence, the theory that those leaks caused the shallow contamination in CPP-79.